

Free DVD
inside

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ct Digital Photography

The in-depth quarterly for the photo enthusiast

Zoom Test

Full-frame vs. APS-C

Composing with Color

The Future of Imaging
Simulated Super-lenses • True 3D

Wi-Fi Camera Test

Slow-motion Video
With Compact Cameras

GIMP Special

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Tools and Techniques

Perfect Portraits

Location secrets, Shooting tips, Gear overview

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My favorite quote on the subject of portrait photography comes from photo consultant and author Martina Mettner, who says, "The idea that a portrait photo can reveal the subject's soul or psyche is one of the most lovingly fostered but nevertheless absurd photographic myths."

This issue focuses on the world of portrait photography with an in-depth look at the work of pro photographer Olaf Ballnus, who captured the shot reproduced here. Our comprehensive workshop takes a look at the gear you need and includes a wealth of insider tips for shooting great portraits, providing proof that the subject doesn't have to be a star to make a great photo.

If Adobe's new licensing model has prompted you to look for alternatives to Photoshop, this issue will be right up your street. We compare the pros and cons of GIMP with the tried and trusted Photoshop approach, and our portrait-editing workshop will help get you started with the powerful GIMP toolset.

Hardware gets a look in too, and we test the theory that full-frame lenses produce better images than native-format lenses when used with APS-C cameras. Some of the results might surprise you.

Have fun with this issue of your favorite photo magazine ...

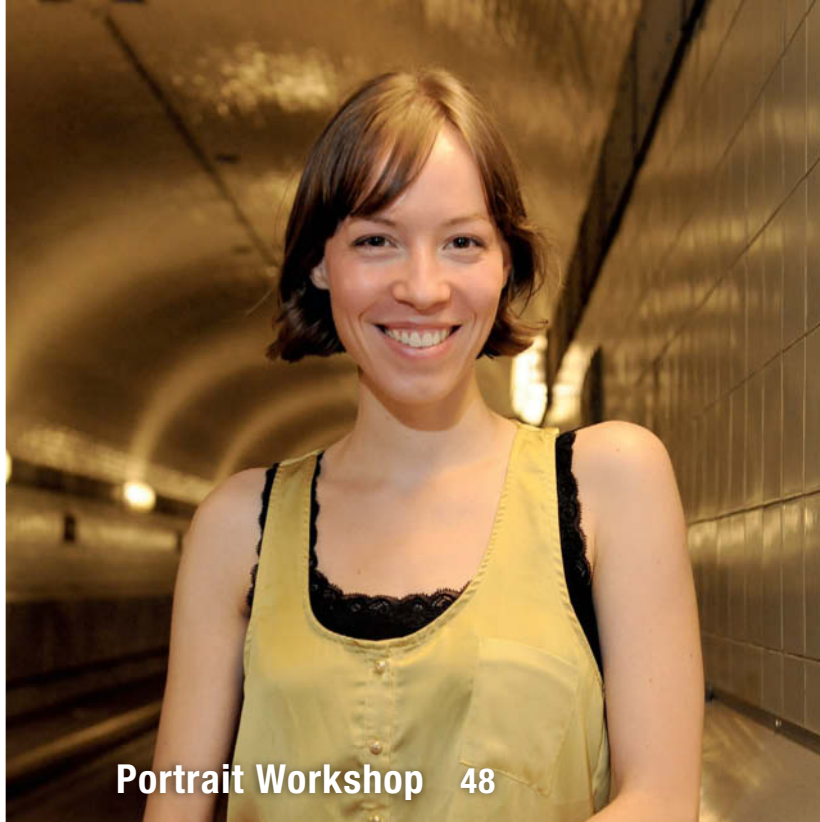
Juergen Rink

Juergen Rink

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Full version software: Beauty Pilot 2.3.0

Producing 'perfect' portraits free from unwanted blemishes isn't always easy, but Beauty Pilot is here to help.

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- Shooting Portraits using a Ring Light
- Creating Atmosphere with Background Patterns
- Portrait Lighting Workshop
- High-speed Video with Compact Cameras
- Wedding Photography Workshop



Reader Forum



Inspiring Cover

I'm writing as an amateur artist who picked up your magazine in the summer because of the artistry of the cover. I've since used the cover as a reference photo for a water-soluble oil painting. *c't Digital Photography*: The in-depth quarterly also for the art enthusiast!

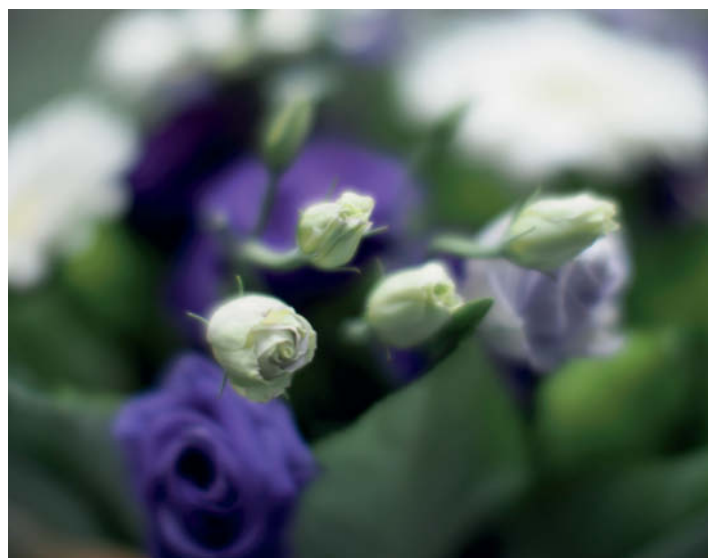
Tracy Paddock

Great Lenses for Speed Freaks

I have been a buyer (soon to be subscriber) since issue #1, which helped persuade me to buy my first M4/3 camera (Olympus E-P2), based on your article on using legacy lenses with adapters on digital cameras. In your 1/2010 issue in the article on high-end legacy lenses, you say, "A 50mm Leica Noctilux becomes a 100mm f0.95 telephoto when used with an MFT camera. We will be testing this dream combo in a future issue." Yes please.

Could you please make it a test of all ultra-fast lenses in the f0.95-f1.2 range, including the Voigtlander Nokton offerings. Please also include the 50mm f/1.1 (Leica M mount) and perhaps even the upcoming Lumix/Leica M4/3 42.5mm f/1.2 with IS and AF. How about the earlier Canon RF f/0.95 50mm, the Leica Noctilux 50mm f/1 (preferred by some for its glow) or the sharper f0.95? And I recall that Nikon also offered a 50mm f/1.2 in RF or SLR mounts.

I am a speed freak lenswise, having two Noktons (25mm f/0.95 and 50mm f/1.1) for my OM-D, as well as the Lumix/Leica 25mm f/1.4.



This shot was captured at f0.95 using a 42.5mm f/0.95 Nokton

I am also planning to buy the Lumix/Leica 42.5mm f/1.2.

Give us a detailed look at the ultra-fast lane! And thanks for a fantastic mag.

Giles Hugo

Bright lenses are indeed a fascinating subject. Look out for our 42.5mm f/0.95 Voigtlander Nokton test in Issue 15. This lens is a real low-light treat for Micro Four Thirds photographers.

c't Digital Photography Seminar Series: Nature Photography

Early in the morning on October 19 about 60 people gathered for the first *c't Digital Photography* photo seminar in Santa Monica.

After morning coffee and a buffet breakfast, the day's events began with Ralph Clevenger, who guided the rapt audience along the "Path of Seeing" as he calls it. Thanks to Ralph, we will all look at nature's myriad subjects in a different way from now on. Tim Mathiesen followed this inspiring talk by sharing his vast experience of panorama shooting. He explained in great detail about suitable cameras and software and surprised us by revealing that some of his greatest panoramas were captured

using compact cameras and even a smartphone.

Have you ever dreamed of earning money with your photos? Ian Shive and JP Harrison gave us the inside line on how to pick the right images for selling at microstock sites.

The final speaker was George Lepp, who is quite a celebrity among nature photographers. He thrilled the audience with his combination of macro and stacked images of the tiniest bugs and details of feathers.

Lively discussions accompanied all the lectures and I am convinced that the first ever *c't* seminar has helped a lot of people to improve their photography skills. (jr)



Tell us what you think:

We are always happy to receive your comments and suggestions in a letter, an e-mail (editor@ct-digiphoto.com) or at www.facebook.com/ct-digiphoto. We reserve the right to abbreviate your input for publication. Our comments are printed in italics.



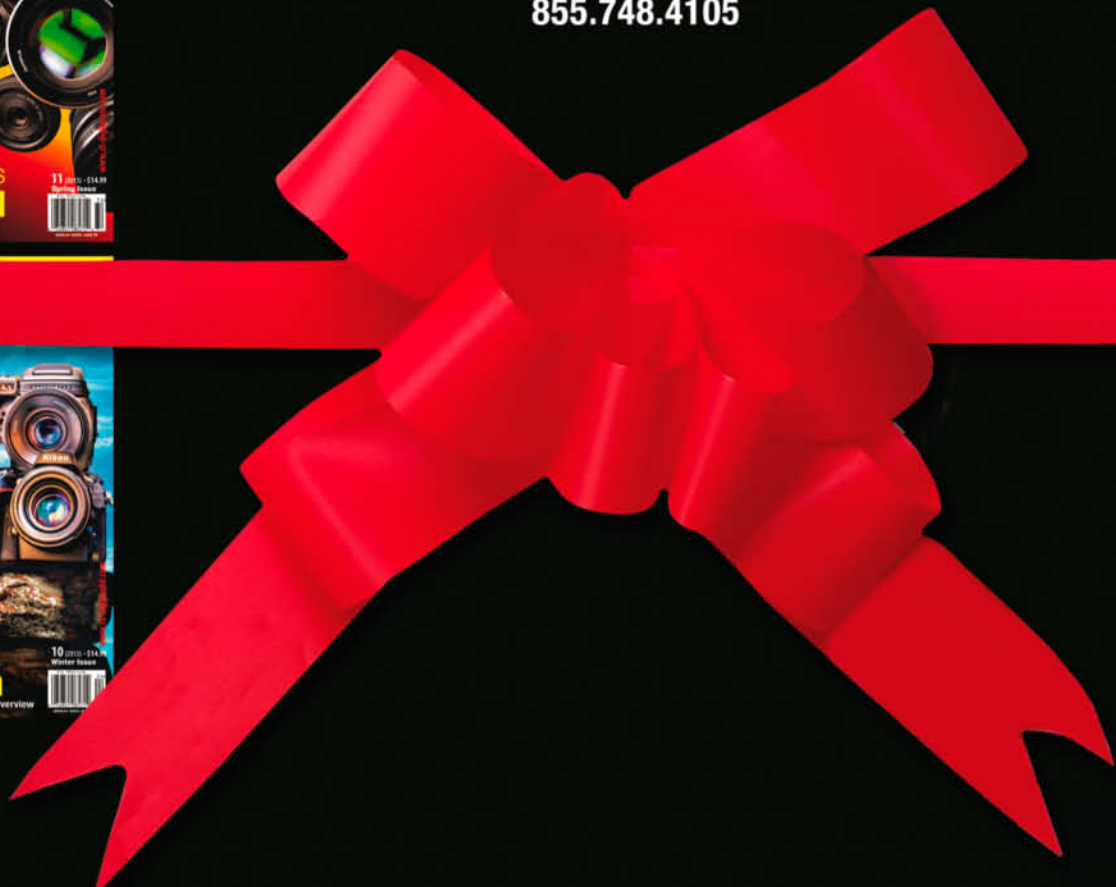
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DVD Highlights & Contents

This issue's free DVD provides a rich selection of photo and editing tools, including a special full version of the *Beauty Pilot* portrait retouching software. And, if you are looking for a value alternative to *Photoshop*, *GIMP* and the plug-ins we have included on DVD will help you deploy the full potential of the open source post-production toolset as part of your own photo workflow.



Portrait Shoot

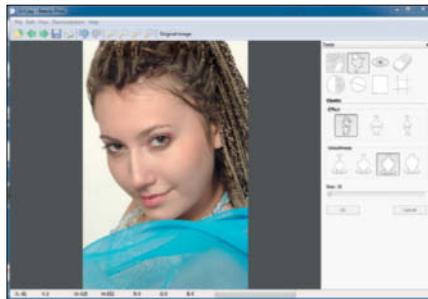
Video tutorial: Portrait expert Bert Stephani uses simple but effective techniques to transform a conventional hotel room into an attractive location.

Bert Stephani is a pro photographer who specializes in creative portrait work. Stephani's studio is a converted barn that he describes as "large, creative, lofty and well equipped." For photographers who have to make do with sub-optimal locations, this tutorial shows you how to use simple equipment and props to get the best out of a space – in this case, a hotel room.

Stephani's aim was to produce atmospheric photos that communicate the easy, carefree feeling of a sunny Sunday morning. The monotone room had a cool atmosphere dominated by pale colors and the solution lay in using a combination of flash, ambient light and a few cleverly positioned props to transform the scene. This video takes you step by step through the process Stephani applied to 'build' the resulting shots.

The footage also includes useful tips on composing foreground and background details and offers advice on camera settings. Experimenting with varying angles of view is an important part of Stephani's approach.

In situations like this, it is essential for the photographer to build up a rapport with the model, and this video demonstrates perfectly how to keep the communication between photographer and model casual but professional. The result is a series of wonderful photos that really do feel as if they were captured in Sunday sunshine. (sea)



Beauty Pilot 2.3.0

Full version software: Producing 'perfect' portraits free from unwanted blemishes isn't always easy, but *Beauty Pilot* is here to help.

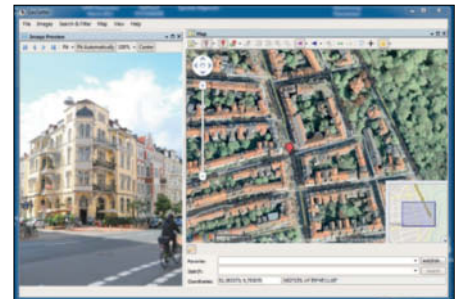
Looking good is hard work, and most photo models go through a rigorous program of makeup, hair and body styling before stepping out in front of the camera.

Particularly in the beauty genre, the creative possibilities offered by today's software are varied and often fascinating. *Beauty Pilot* is a dedicated portrait retouching tool, and this issue's DVD includes a special full version of the software for you to try out.

The software is a kind of 'digital beauty parlor' and is perfect for cleaning up all kinds of skin blemishes. Just a few simple clicks are all that is required to 'iron out' a portrait.

The 'Soft-focus Lens' feature makes it easy to produce smooth skin tones and the 'Elastic' tool enables you to easily manipulate the shape of your subject's physical features to fit the job at hand. Straightening someone's nose has never been easier. The 'Eye Color' tool provides a simple way to alter the look of your subject's eyes using colors selected from a dedicated picker. There are no limits to the alterations you can make, and the 'Original Photo' feature enables you to compare each change with the original version of your image while you experiment.

Our DVD includes a free full version of *Beauty Pilot 2.3.0* and the code you need to activate it. *c't Digital Photography* readers also receive a special 50% discount on updates. This offer is valid until May 18th 2014. (sea)



GeoSetter 3.4.16

Free software: Using geodata is a great way to keep your photos sorted, and *GeoSetter* is a powerful geotagging tool.

Digital technology has made producing photos much cheaper than it was. In today's photographers shoot many more photos than their predecessors, often returning home from a trip with hundreds or even thousands of photos 'in the bag'.

Keeping such enormous numbers of images sorted is one of the great challenges of the digital age. Alongside using date and time data, using geodata to sort and display photos on digital maps is an increasingly popular approach. *GeoSetter* is a powerful tool for helping you visualize just where you captured your favorite shots.

Basic geodata such as longitude, latitude, altitude and angle of view can be captured and written to a file's Exif data using the GPS modules built into many of today's cameras. Easily available accessory modules or tracking apps for smartphones and tablets can also be used to record tracking data, which can then be associated with the appropriate photos using software like *GeoSetter*, which can also help you find locations on a map and add appropriate tags to untagged photo files. The software includes IPTC editing and date change functionality and enables you to synchronize tags between RAW images and their corresponding JPEGs.

This issue's free DVD includes the Windows desktop version and the portable version of *GeoSetter 3.4.16*. (sea)



Image Processing Tools

Windows

Beauty Pilot 2.3.0 **full version**
 Inkscape 0.48.4
 Inkscape Portable 0.48.4
 Plug-In Switch 1.3
 StylePix 1.13.0.4
 StylePix Portable 1.13.0.4

Mac OS

Inkscape 0.48.4

GIMP & Plug-ins

Windows

15 Vector Brushes
 Grunge Brush Pack
 More Mask Brushes
 Scratchies Brushes
 GIMP 2.8.6
 GIMP Portable 2.8.6
 GREYC's Magic Image Converter (G'MIC) 1.5.7.1
 Color to Mask Pro 1.0
 Cool Look filter
 Export Layers
 Layer Effects
 MathMap 1.3.5
 YUV Temperature
 PSPI 1.0.7
 UFRaw 0.19.2

Mac OS

15 Vector Brushes
 Grunge Brush Pack
 More Mask Brushes
 Scratchies Brushes
 GIMP 2.8.6
 GREYC's Magic Image Converter (G'MIC) 1.5.7.1
 Color to Mask Pro 1.0
 Cool Look filter
 Export Layers
 Layer Effects
 MathMap 1.2.4
 YUV Temperature

Linux

15 Vector Brushes
 Grunge Brush Pack
 More Mask Brushes
 Scratchies
 GREYC's Magic Image Converter (G'MIC) 1.5.7.1
 Color to Mask Pro 1.0
 Cool Look filter
 Export Layers
 Layer Effects
 PSPI 1.0.7

Photo Tools

Windows

ExifTool 9.37
 GeoSetter 3.4.16
 GeoSetter Portable 3.4.16
 Geotag 0.086

GPSBabel 1.4.4
 Helicon Photo Safe 3.90
 Hugin 2012.0.0
 IrfanView 4.36
 IrfanView PlugIns 4.36
 IrfanView Portable 4.36
 The Rasterbator 1.21

Mac OS

ExifTool 9.37
 Geotag 0.086
 GPSBabel 1.4.4
 Hugin 2012.0.0
 MacPorts 2.2.0

Linux

ExifTool 9.37
 Geotag 0.086
 GPSBabel 1.4.4

Sample Images

Camera Test Sample Images
 APS-C Cameras with Full-frame Lenses

Videos

Shooting Portraits with Ring Light
 Creating Atmosphere with Background Patterns
 Portraits Lighting Workshop
 High-speed Video with Compact Cameras
 Wedding Photography: Workshop with Mike Larson

Get in the Picture



c't Digital Photography gives you exclusive access to the techniques of the pros

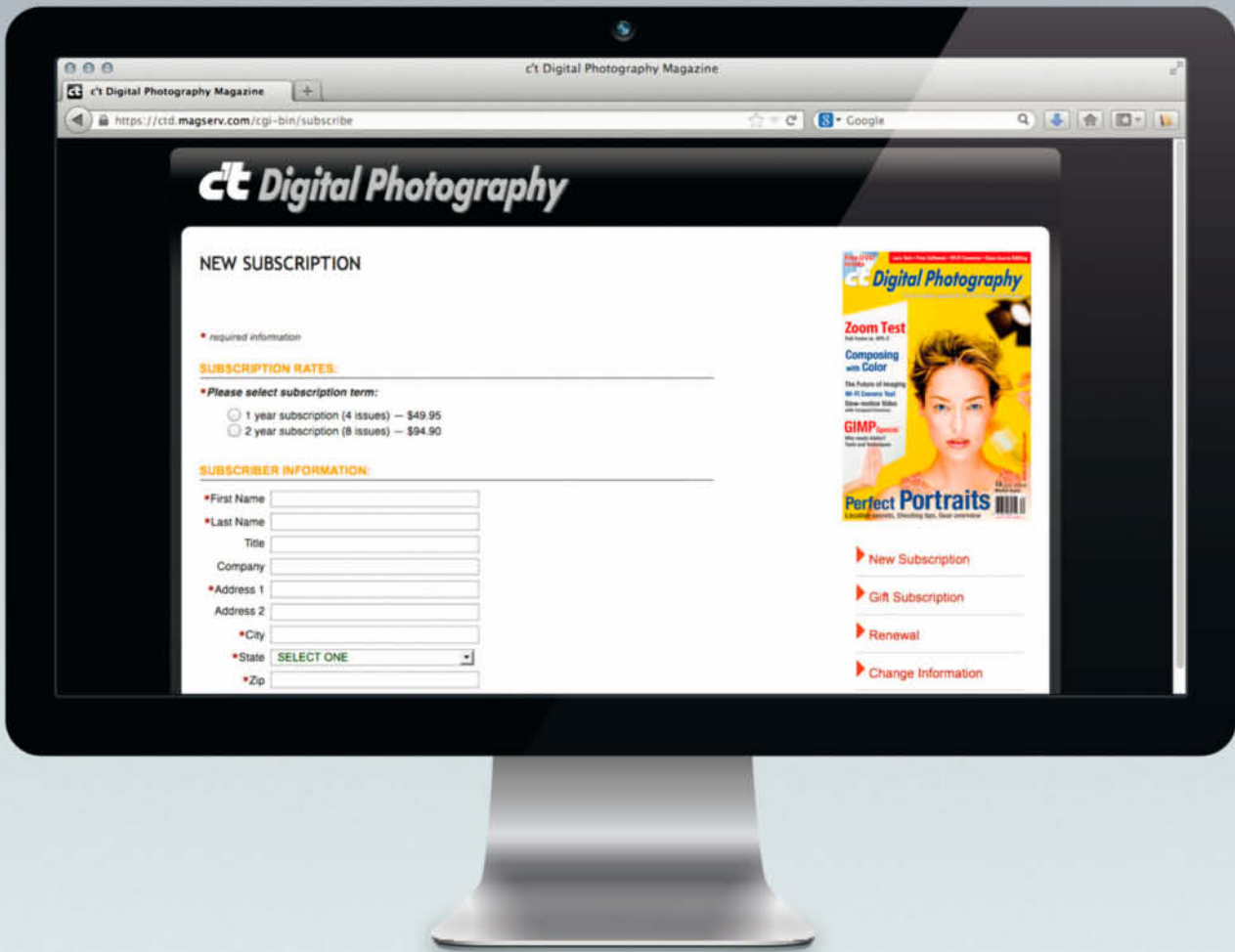
Keep on top of the latest trends and get your own regular dose of inside knowledge from our specialist authors. Every issue includes tips and tricks from experienced pro photographers as well as independent hardware and software tests.

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Portfolio

Jun Ahn

Jun Ahn is a young South Korean who photographs herself in breathtaking poses in and on skyscrapers. Along with her *Invisible Seascape* and *Float* sequences, these images have firmly established her presence on the international photography scene.

Self-portrait 2011





Self-portrait 2012



Self-portrait 2011

Jun Ahn has been working on her self-portrait project since 2008, and the images are sure to get you catching your breath, even if you don't suffer from vertigo. We see her climbing out of windows, balancing on the edges of roofs or apparently preparing to leap into nothingness. The free-fall perspective and the often wrenching feeling these images produce in the viewer's gut guarantee that you won't forget them.

She wears the same thin blue dress, without shoes or jewelry, in many of the images, emphasizing the impression of a defenseless creature trapped in a gigantic cityscape. We find ourselves asking whether she is aware of the danger of the situation in which we see her.

Jun Ahn only rarely shows her face and often shoots self-portraits with her back to the camera – the pose that some of her most impressive images are based on. Deliberate

blur often underscores the feeling of lifting off into the unknown. Broad-ranging notions, such as 'life and death' or 'past and future' immediately suggest themselves when viewing these images.

Ahn sometimes has to wait months to get permission to shoot in her chosen location, but has already managed to capture images in and on more than a dozen buildings in Seoul, New York and Hong Kong. She shoots using an 'enough is never enough' approach, switching her camera to drive mode and only stopping when the memory card is full. From the thousands of shots that result, she selects the ones in which she doesn't appear too scared, which gives her quite a limited choice!

In an interview with the British Journal of Photography (BJP), she talks about the concept behind her work. She is always on the lookout for scenes that seem unconstrained by time and space, in which



Self-portrait 2009



she can capture a moment without context that would otherwise be lost forever. Her *Invisible Seascape* project is made up of full-frontal shots of waves and foam that scream of fleeting moments, whereas *Float* portrays rocks and stones adrift in the middle of nowhere, and it is not at all clear whether the subjects are still lifes, the result of a recent explosion or something else entirely.

These three projects have been the launchpad for Jun Ahn's international career, and have led to solo shows in St. Petersburg, Seoul and Hong Kong. She started studying photography in graduate school and was awarded an MFA with honors at Parsons The New School for Design in New York. She is currently studying for her doctorate at Hongik University in Seoul. (jr)

Jun Ahn
www.ahnjun.com
Kips Gallery
www.kipsgallery.com



Self-portrait 2010

Self-portrait 2011



Self-portrait 2009



Self-portrait 2008



Thomas Hoffmann, Sophia Sieber

Full-frame vs. APS-C Lenses

In an attempt to squeeze the very last drop of quality out of their gear, some photographers use full-frame lenses with APS-C camera bodies. Since these cost more and are much heavier to carry, we decided to investigate whether this 'hybrid' concept provides real, measurable benefits. We tested the Canon EOS 7D, the Nikon D7100 and the Sony SLT-A77 with a range of full-frame lenses and compared the results with those produced by the same cameras using their 'native' APS-C equivalents. Some of our findings were quite surprising.



The lens is the most important part of a camera, because it not only creates the image that the sensor captures but also determines its quality. It is therefore essential to choose your lenses carefully. The idea that using full-frame lenses is the best way to get the best-quality images out of an APS-C camera is persistently propagated in countless online forums.

The arguments in favor of this idea are clear, and are based on the size of the image circle produced by a full-frame lens. In the illustration below, for example, the diameter of the image circle is about 43.3 mm, compared with the 27-28 mm diameter of an APS-C image circle. It is in the nature of optics that the number of aberrations and artifacts (such as vignetting effects and distortion) increases toward the edge of the image circle, while the center of the image circle is largely free of such anomalies. Because an APS-C sensor only covers the center portion of the full-frame image circle, images produced this way should, theoretically, suffer less from vignetting, distortion and loss of sharpness toward the edges of the frame.

Pixel Size is Critical

There are, however, other details to be considered too. The size of the individual pixels that make up the sensor is one such critical factor. Although APS-C sensors are a

lot smaller than their full-frame counterparts, they are not small enough to eliminate all image artifacts when they are used with full-frame lenses.

Distortion, chromatic aberrations and vignetting effects don't only appear at the edges; they can occur across the entire image circle. Contemporary lenses, especially zooms, have complicated designs that produce complex 'mixed' barrel and pincushion distortion. Due to the way they are built, bright, wide-angle lenses are particularly susceptible to vignetting effects, and the best way to avoid these is to stop the aperture down. The only way to construct a wide-angle lens that produces very little vignetting and distortion is to use large, heavy glass elements, which brings us neatly back to the idea of using larger (i.e., full-frame) lenses to do the job instead.

Although specially coated glass can help to reduce chromatic aberrations, these can crop up anywhere within the frame and are often of varying colors, so they are difficult to eliminate completely.

The size of the individual pixels in relation to the size of the sensor – known as pixel density – also affects the quality of the results. An APS-C sensor with the same number of pixels as a full-frame sensor will usually draw the short straw, unless your lens is capable of resolving an extremely high number of line pairs per millimeter. If this is not the case, you will have to deal with

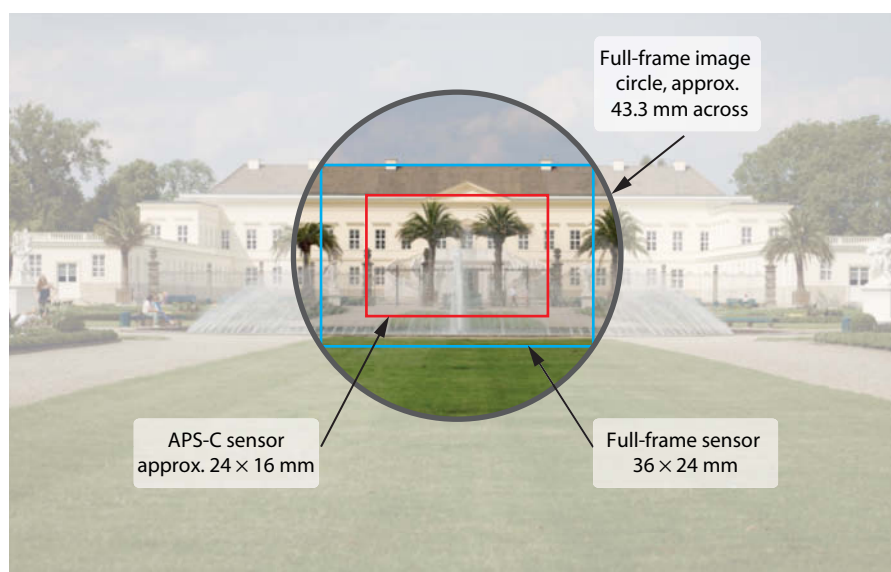
poorer resolution. The Nikon D7100 and the Sony SLT-A77, with their 24-megapixel sensors, therefore present a real challenge to any lens. Extrapolated to full-frame size, such dense sensors would have a resolution of 54 megapixels, compared with the current market leader in this field, the Nikon D800, which has a 36-megapixel sensor.

Putting It to the Test

So much for the theory! The only way to find out which lenses really work best with which cameras is to test them. We got hold of a Canon EOS 7D, a Nikon D7100 and a Sony SLT-A77, which cover three different systems and provide the best APS-C technology currently on offer. These are all highly versatile cameras that are well suited to enthusiast or semi-professional use.

For our comparison test, we selected the Canon EF-S 17-55mm f/2.8 IS USM Zoom, the Nikkor 17-55mm f/2.8 and the Sony SAL 16-60mm f/2.8 APS-C lenses and set them up against their 24-70mm counterparts from the full-frame world. We chose the Canon EF 24-70mm f/4.0 variant, mainly because its f/2.8 sister costs a stratospheric US\$2,300.

To round things out, we also decided to test some third-party manufacturers in the shape of a Sigma 24-70mm Sony lens, a Tamron 24-70mm for our Nikon and a Tokina 17-35mm f/4 for our Canon EOS 7D.



Rather than exploiting the entire image circle produced by a full-frame lens, an APS-C sensor uses a smaller segment in the center. In theory, this should produce fewer image errors and artifacts.



We tested all our camera/lens combos in real-world outdoor situations as well as in the lab. This is one of the rare occasions on which you will find our enterprising c't editors at work in a rose garden!

Lab and Real-world Testing

To give us the most objective comparison values possible, we put our lenses through a stringent lab test (see 'How We Tested' on the following pages for more details) as well as taking them for a spin under real-world shooting conditions in the Herrenhausen Gardens in Hanover, which challenged

our test lenses with plenty of color and detail.

Lenses with constantly bright apertures require large, high-quality glass elements in their designs, so they weigh quite a lot – we felt we could have done with a golf caddy or at least a donkey to help us carry all the gear we collected. Remember to consider the weight of a lens when you are planning

a purchase – after all, what use is a fantastic lens if it is too heavy for your planned shoot?

We ended up making several trips carting more than 10kg (22 lbs) of gear through Hanover and back, not including our tripod, notebook and other odds and ends. You can read the results of all this effort starting on page 26.

How We Tested

The following sections explain how we conducted our lens comparison tests. There are also additional detailed lens analyses included on this issue's free DVD, and we explain how to interpret these below.

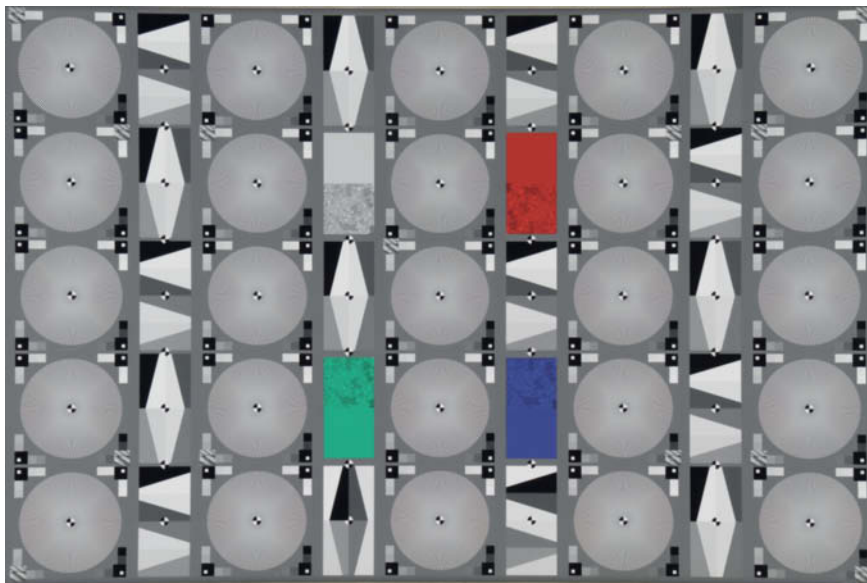
Resolution

To start with, we had our in-house lab analyze all our test lenses. Because it is impossible to rate a lens independently from a camera, we tested three different lenses for each of our three test systems, using the same EOS 7D, D7100 and SLT-A77 bodies.

Resolution was tested using a chart made up of 25 Siemens stars with sine wave-shaped brightness gradients. We photographed the chart to fill the frame twice: once using the maximum aperture and once stopped down by 2 EV. We focused manually and captured about 10 shots for each combination of aperture and focal length. We then used custom software to evaluate the contrast between the brightest and darkest parts of each image for all measurable frequencies. As the frequency increases – i.e., as the details become finer – this contrast decreases to a value of 10 percent, beyond which the details in question are no longer distinguishable. We then calculated the average cutoff frequency, measured as the ratio of line pairs to frame height for various directions within each Siemens star. Our tables of results below and the results we have included on this issue's free DVD consist of separate measurements for the center and the (averaged) edge of the frame.

Distortion

For a test like this, distortion is defined as the tendency of a lens to reproduce straight lines looking curved – a phenomenon that is particularly prevalent at the edges of photographic images. If distortion is present, a rectangular object will end up looking either barrel- or pin-cushion-shaped, or, in the case of some modern zoom lenses, will show a wave-shaped combination of both forms. We analyzed this aspect of our test lenses using a chart made up of printer's register marks and used it to determine the distance between each point on the photographed chart and its equivalent position under assumed 'ideal' conditions. The results for this section are expressed



Twenty-five Siemens stars spread across the entire frame gave us a solid basis for analyzing the resolution of our test lenses

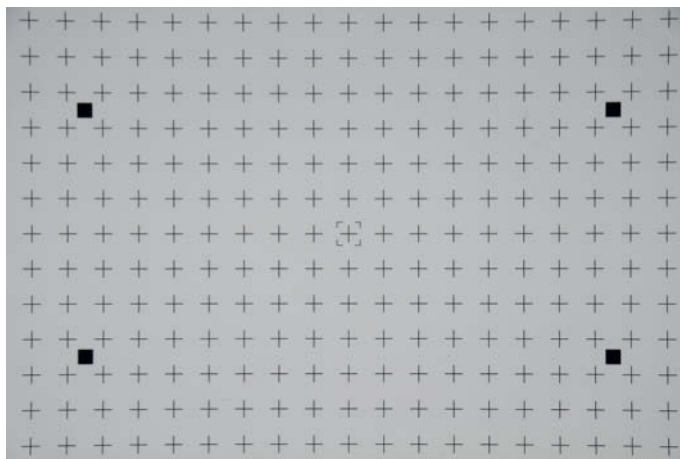
in terms of the degree of bend in a line at the edge of the frame in proportion to its height.

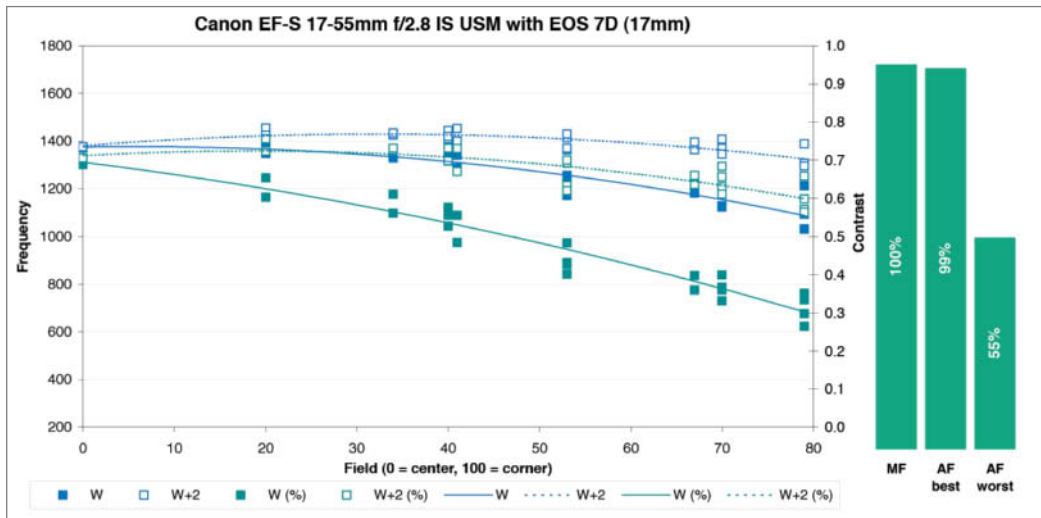
Vignetting

The term 'vignetting' is used to describe the disproportionately dark tones that often occur in gray areas at the edges and corners

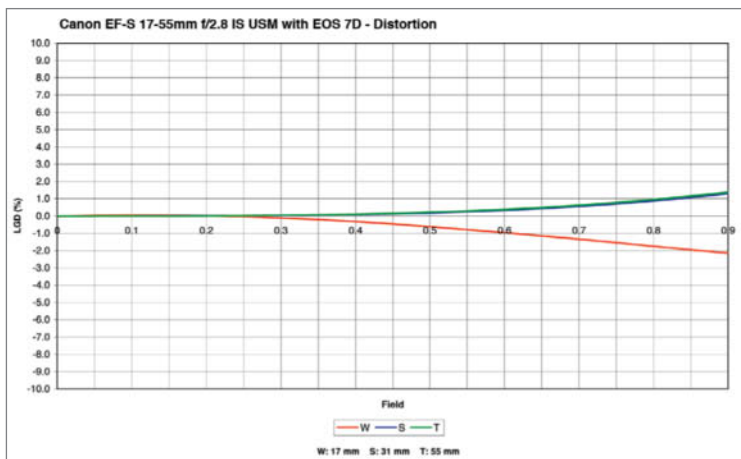
of the frame – a phenomenon that is not limited to consumer-grade cameras with cheap mass-market lenses. This value was measured using a frosted glass illuminated extremely evenly by an integrating sphere. For the zoom lenses, we recorded values in 1,200 places within the frame at three different focal lengths, each focused at infinity.

We used a chart filled with register marks to find out how much edge distortion our lenses produced



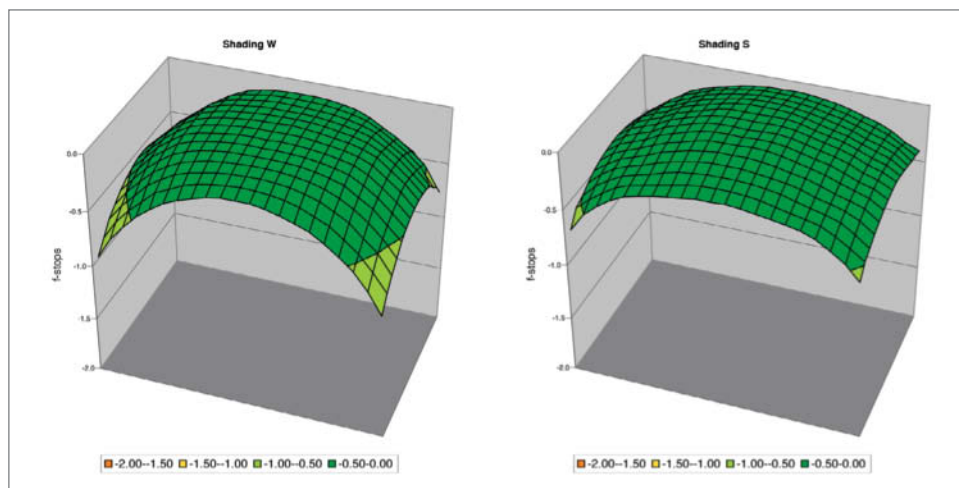


The PDFs with the individual lens analyses that you can find on this issue’s free DVD include MTF charts like the one reproduced here. The curves indicate the number of distinct line pairs that the lens in question can reproduce, measured over the height of the frame. The x-axis represents the frame from the center (0) to the edge (100), while the y-axis enumerates the number of line pairs recorded for each x value. The far left-hand vertical axis indicates the degree of contrast (i.e., the perceived sharpness). The bar charts at far right show the best and worst resolution values recorded by each camera’s autofocus system.



The distortion charts use the x-axis to indicate the range from the center to the edge of the frame and the y-axis to indicate the deviation in the height of the frame at the edge compared to the height in the center, measured as a percentage

These three-dimensional charts show the degree of shading for the entire frame, measured in f-stops. The further the corners sag, the greater the vignetting effect.



Canon EF-S 17-55mm f/2.8 IS USM

The Lens: With its constant maximum aperture of f2.8, this model is one of the brightest Canon APS-C zooms on offer. It has an equivalent focal length range of 27-88 mm and weighs 650 g (about 1½ lb), making it one of the lighter models among the bright lenses we tested. Its light weight is due mainly to the large number of plastic components, and the zoom ring especially appeared quite fragile during our test. If you use this lens with the camera tipped forward, we recommend that you check that the zoom setting hasn't changed before releasing the shutter.

Test Results and Image Quality: The lens delivered similar results across the entire zoom range but showed weakness at its widest aperture, especially at the telephoto end of the scale. Our EOS 7D achieved center resolution of 1430 and edge resolution of 1084 line pairs, which equates to about 60 per cent of its maximum potential. The chromatic aberration score of 1.1-1.3 pixels is quite high. Vignetting darkened the edges of the frame by almost a whole stop and the lens produced both barrel and pincushion distortion. However, these anomalies were fairly uniform and shouldn't be too difficult to eliminate digitally.

Image quality matched our lab measurements, and the lens produced clear outdoor results with plenty of contrast but very slightly less sharpness than we would have liked. The flower images clearly demonstrate the Canon's edge weakness. Overall, it produced its best results at apertures between f4 and f11. Beyond f16, images became visibly less sharp.

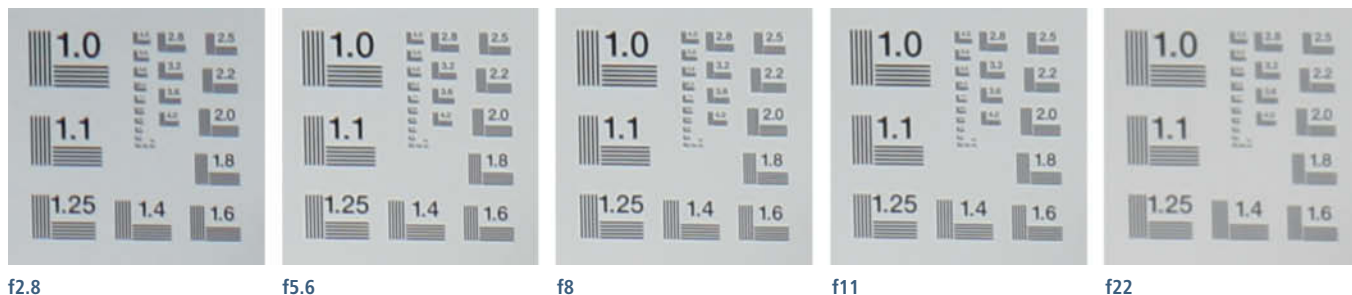


EF-S 17-55mm f/2.8 IS USM	
Aperture range / Number of blades	f2.8-f22 / 7
Focal lengths (35mm equivalent)	17-55 mm (27-88 mm)
Price (approx. US\$)	900
Measured at¹	maximum aperture / -2 stops
Center resolution	82% / 83%
Edge resolution	72% / 78%
Chromatic aberration	1.1 pixels
Distortion	1.5%
¹ Using mid-range focal length	



Top left-hand corner of the c't test scene

ISO 100 | 55 mm | f5.6 | 1/800s



Canon EF 24-70mm f/4.0L IS USM

The Lens: This is a versatile full-frame standard zoom with a constant maximum aperture of f4. It also features a macro setting that offers 0.7x magnification (see page 29 for a sample macro image). This feature makes it really stand out among our test lenses. Build quality is very good in spite of its relatively light weight of 600 g (1 1/3 lb).

Test Results and Image Quality: The uninspiring results we achieved bore out the fact that this lens is not designed for use with an EOS 7D. With regard to resolution, the lens performed on a par with its APS-C counterpart in the center but produced much less fall-off toward the edges of the frame. The results of using the lens wide open or stopped down differed only slightly. This particular camera/lens combo achieved 81 per cent of its theoretical maximum center resolution wide open and 82 per cent stopped down at its shortest focal length. The results were more disappointing at a medium (41mm) focal length setting, delivering just 66 per cent resolution in the corners when wide open. Chromatic aberration was only slight at 0.6-0.9 pixels and vignetting effects were minimal, with only half a stop difference at maximum aperture and 70mm focal length. The lens also scored highly with its virtually distortion-free rendition.

Outdoor shots generally showed very good detail contrast and well rendered textures. This model also produced its best results between f4 and f11, with some muddiness setting in at f16 and beyond.

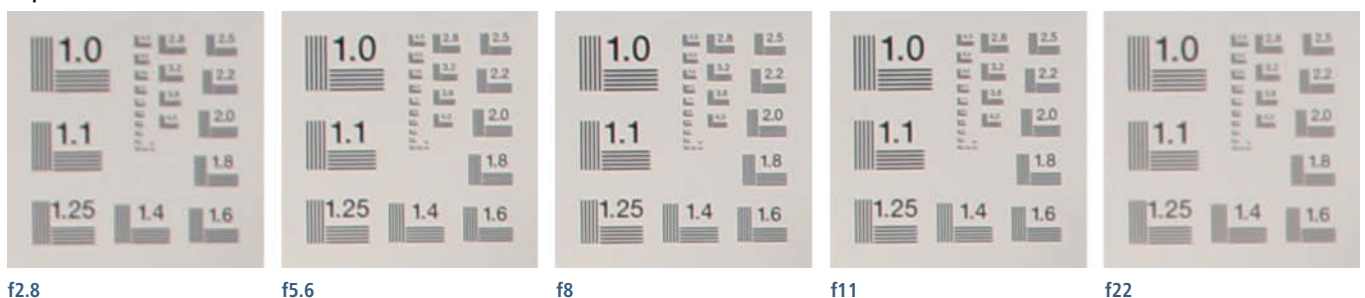


EF 24-70 mm f/4.0L IS USM	
Aperture range / Number of blades	f2.8-f22 / 9
Focal lengths (35mm equivalent)	38-112 mm (24-70 mm)
Price (approx. US\$)	1,500
Measured at¹	maximum aperture / -2 stops
Center resolution	77% / 76%
Edge resolution	66% / 78%
Chromatic aberration	0.8 pixels
Distortion	0%
¹ Using mid-range focal length	



Top left-hand corner of the c't test scene

ISO 100 | 70mm | f5.6 | 1/800s



Tokina AT-X 17-35mm f/4 Pro FX

The Lens: This Tokina is a wide-angle zoom designed for use with full-frame cameras and we tested the Canon version. The lens has no built-in stabilizer and, to focus manually, the user has to decouple the focus ring from the camera's motor by pulling it back toward the camera, which means that the otherwise solid build suffers from an unnecessarily 'loose' element. In contrast, the zoom ring has a pleasantly firm movement that doesn't move unintentionally. The length of the lens doesn't change when you adjust focus and/or focal length. Weighing in at 600 g (1 1/3 lb), the Tokina is averagely heavy for the performance it offers.

Test Results and Image Quality: With this lens, the manufacturer has concentrated on delivering optimum wide-angle performance. It produced much better results than those of the Canon 17-55mm, showing virtually no loss of edge sharpness when used stopped down. Unfortunately, performance drops off noticeably toward the edges of the frame at longer focal lengths, and we measured less than 1000 line pairs at maximum aperture and 35 mm. The difference between wide open and stopped down performance was particularly clear. Relative to the other lenses we tested, chromatic aberration was quite high at 1.7 pixels, but distortion and vignetting both landed top marks in the Canon segment, with just 0.2 stops of shading at the telephoto end and -1 per cent wide-angle distortion. Autofocus often missed its mark and could do with improvement.

Outdoors, the lens produced obvious fringing at high-contrast edges, especially in the corners of the frame, and there was obvious resolution fall-off at longer focal lengths.

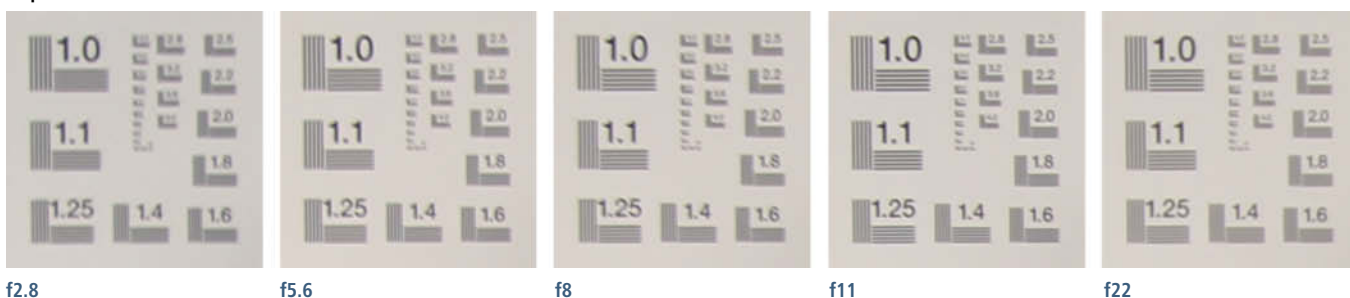


AT-X 17-35mm f/4 Pro FX	
Aperture range / Number of blades	f4-f22 / 9
Focal lengths (35mm equivalent)	27-56 mm (17-35 mm)
Price (approx. US\$)	550
Measured at¹	maximum aperture / -2 stops
Center resolution	80% / 81%
Edge resolution	65% / 74%
Chromatic aberration	1.7 pixels
Distortion	-0.2%
¹ Using mid-range focal length	



Top left-hand corner of the c't test scene

ISO 100 | 35 mm | f4 | 1/1600s





The Canon 24-70mm f/4 has built-in macro functionality that allows shooting at distances as close as 40 cm and magnifications up to 0.7×
ISO 100 | 80 mm | f4 | 1/400 s | +0.3 EV

Nikon AF-S DX Zoom-Nikkor 17-55mm f/2.8G ED-IF

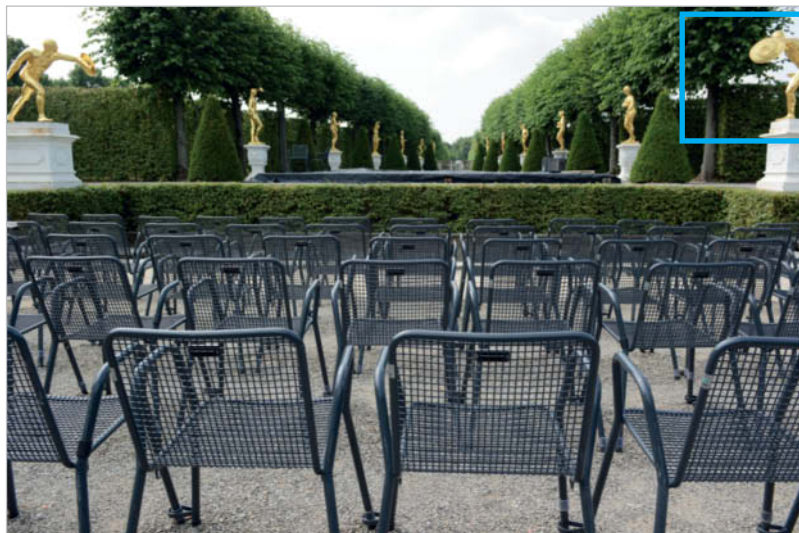
The Lens: Nikon's APS-C standard zoom is a tank of a lens that is extremely well built and feels good to use. The only drawback of its high build quality is that it weighs 755 g (1 3/8 lb), which makes it something of a burden when traveling. This particular model has been available for nearly 10 years and was designed at a time when DSLRs offered much lower resolution, so we were really excited to see how it performed with the D7100's 24-megapixel sensor.

Test Results and Image Quality: The Nikkor's real strengths lie in its wide-angle and standard lens performance, recording more than 80 per cent of its potential resolution wide open. Things don't look quite as impressive at the long end using maximum aperture, and we recorded obvious edge weakness (i.e., less than 1000 line pairs) at all apertures. Wide-angle barrel distortion came in at -1.1 per cent and vignetting measured almost a whole stop wide open but was virtually non-existent stopped down. Chromatic aberration remained constant throughout the aperture range at an acceptable 0.6 pixels.

Our real-world test mirrored our lab values, and the images we captured had clear, sharp center definition but insufficient detail contrast at the edges. This weakness is well demonstrated by the gold statue, which shows a lack of detail and obvious fringing.

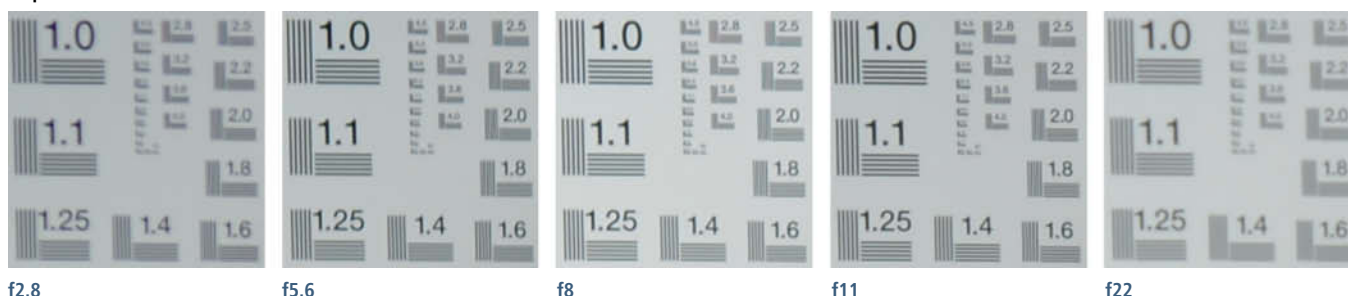


AF-S DX Zoom-Nikkor 17-55mm f/2.8G ED-IF	
Aperture range / Number of blades	f2.8-f22 / 9
Focal lengths (35mm equivalent)	17-55 mm (24-70 mm)
Price (approx. US\$)	1,400
Measured at¹	maximum aperture / -2 stops
Center resolution	81% / 83%
Edge resolution	60% / 70%
Chromatic aberration	0.6 pixels
Distortion	-0.2%
¹ Using mid-range focal length	



Top left-hand corner of the c't test scene

ISO 100 | 35 mm | f4 | 1/1600s



Nikon AF-S Nikkor 24-70mm f/2.8G ED

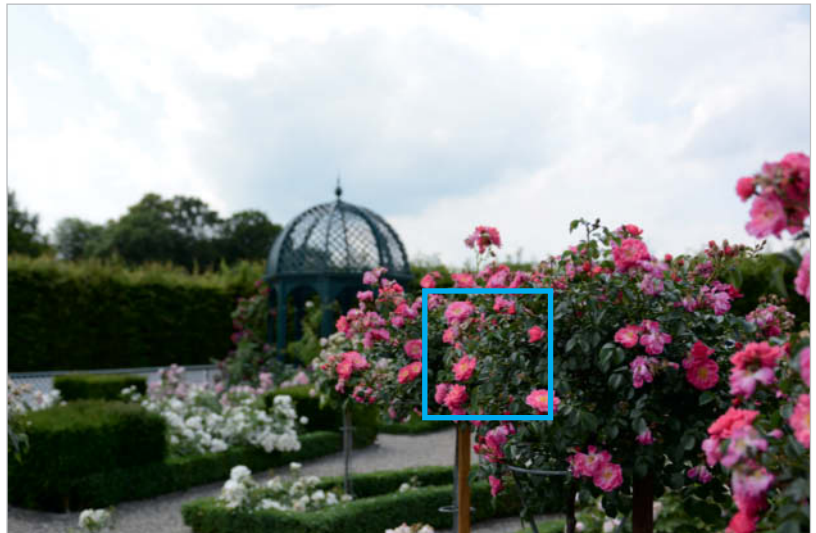
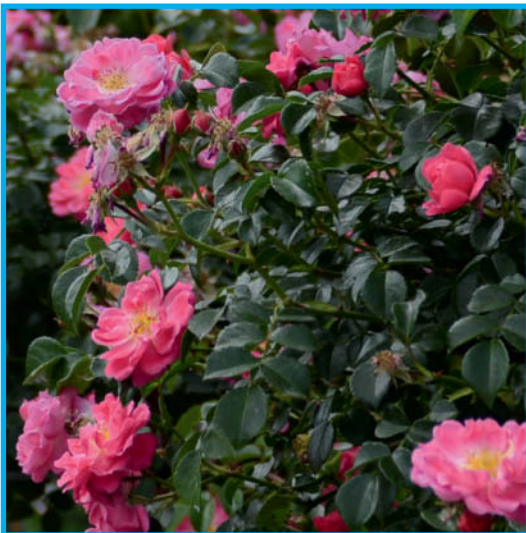
The Lens: The AF-S Nikkor 24-70mm f/2.8G ED belongs to the 'holy trinity' of Nikon full-frame, constant-aperture f/2.8 zooms. Build quality is extremely good and includes a rubber diaphragm that protects the bayonet coupling from dust and water damage. The zoom and focus rings work smoothly and precisely and the built-in ultrasonic motor provides fast, almost silent autofocus. All this technology has its downside: the lens is 13 cm (5.2") long and weighs 900 g (nearly 2 lb), which of course makes it less of a joy to lug around. Only its lack of an image stabilizer keeps it to a usable size.

Test Results and Image Quality: In spite of producing over 90 per cent resolution (1803 line pairs) in the center at maximum aperture, the AF-S confounded our expectations and showed a significant loss of wide-angle resolution toward the edges of the frame, recording values as low as 50 per cent. This loss of sharpness was not as drastic at medium focal lengths but was accompanied by lower center resolution of 1644 line pairs (82 per cent). Chromatic aberration was generally negligible, increasing only to 0.7 pixels at the telephoto end. Vignetting and distortion were also minimal and autofocus was extremely accurate. We were only able to produce better manual focus results at the very long end of the zoom scale.

Our outdoor test showed that the edge weakness revealed in the lab didn't matter so much in the real world. Used at f5.6, the lens produced consistently high resolution and very pleasing depth of field.

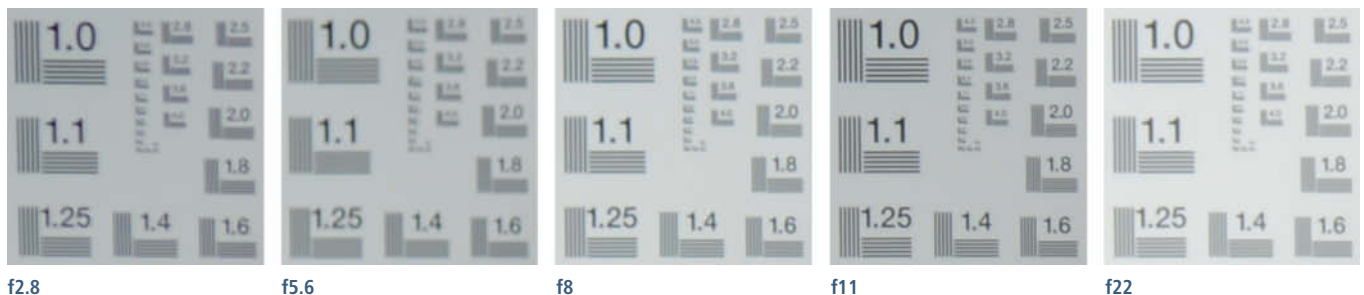


AF-S 24-70mm F/2.8G ED	
Aperture range / Number of blades	f2.8-f22 / 9
Focal lengths (35mm equivalent)	36-105 mm (24-70 mm)
Price (approx. US\$)	1,900
Measured at¹	maximum aperture / -2 stops
Center resolution	87% / 85%
Edge resolution	73% / 77%
Chromatic aberration	0.7 pixels
Distortion	0%
¹ Using mid-range focal length	



Top left-hand corner of the c't test scene

ISO 100 | 24 mm | f2.8 | 1/2000 s



Tamron SP 24-70mm f/2.8 Di VC USD

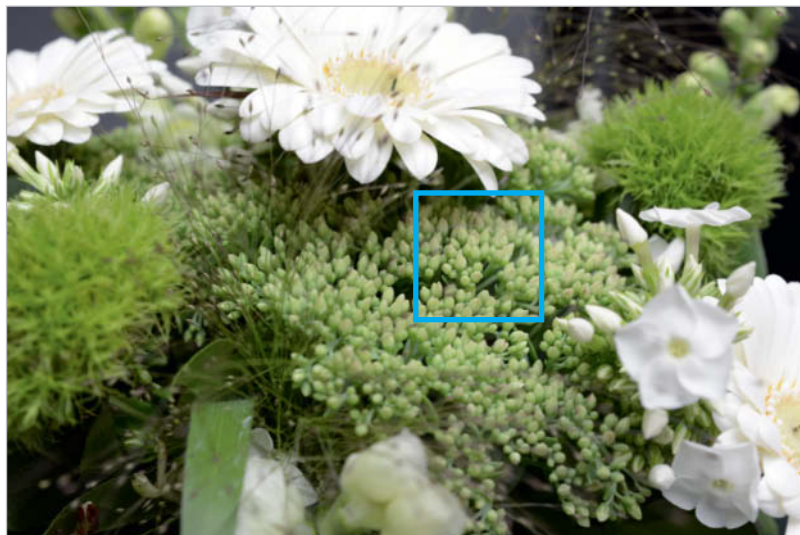
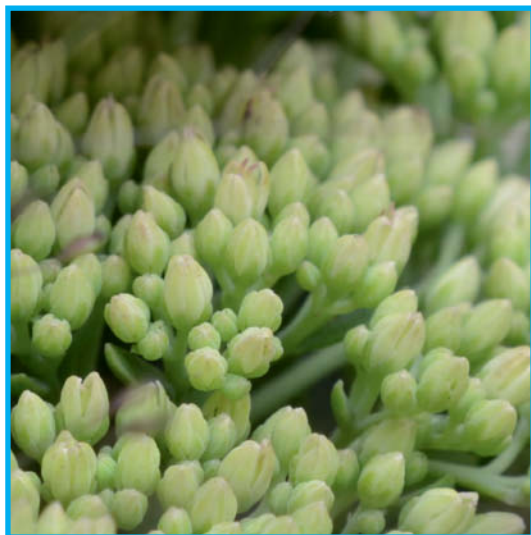
The Lens: Tamron’s full-frame standard zoom is equipped with an image stabilizer, an ultrasonic motor and a bright maximum aperture, and is very well built and finished. Its moving parts work smoothly without any looseness and the zoom is stiff enough to remain unperturbed by gravity. Like its Nikon counterpart, the Tamron is large and heavy, weighing in at over 800 g (more than 1¾ lb) and measuring almost 12 cm in length.

Test Results and Image Quality: The lens provided solid performance in the lab, in spite of an obvious loss of resolution at the edges of the frame. It produced its best results at its wide-angle setting, losing sharpness toward the telephoto end of the range. At 70 mm with the aperture wide open we measured 1526 line pairs in the center but only 1090 at the edge of the frame. Stopping down improves the results significantly. Chromatic aberration was minimal at all focal lengths and vignetting of 0.5 stops is a non-issue at wide-angle settings. Distortion was more obvious, hitting -2.8 per cent at the wide-angle end. Autofocus was most reliable at medium focal lengths and often missed the mark at both ends of the zoom scale.

The Tamron benefitted from stopping down in the real world too. However, our images began to lose sharpness beyond f11. Overall, our outdoor results mirrored those we produced in the lab and confirmed the presence of significant distortion at wide-angle focal lengths.

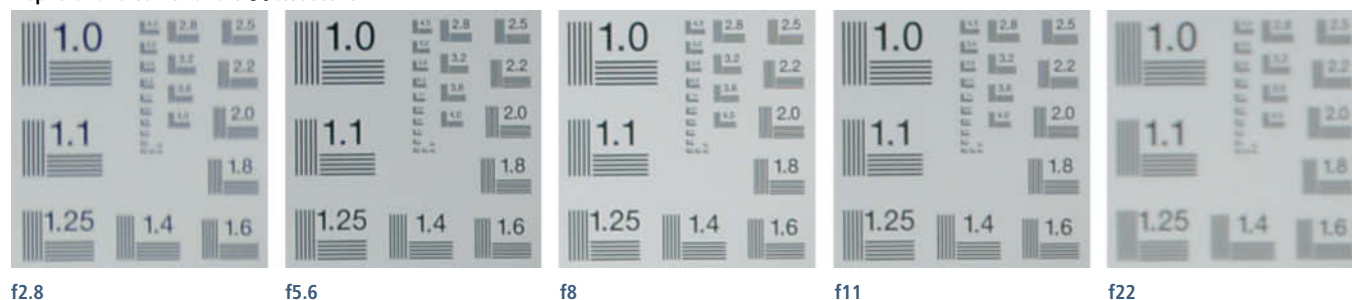


24-70mm f/2.8 Di VC USD	
Aperture range / Number of blades	f2.8-f22 / 9
Focal lengths (35mm equivalent)	36-105 mm (24-70 mm)
Price (approx. US\$)	1,300
Measured at¹	maximum aperture / -2 stops
Center resolution	84% / 91%
Edge resolution	66% / 74%
Chromatic aberration	0.6 pixels
Distortion	0%
¹ Using mid-range focal length	



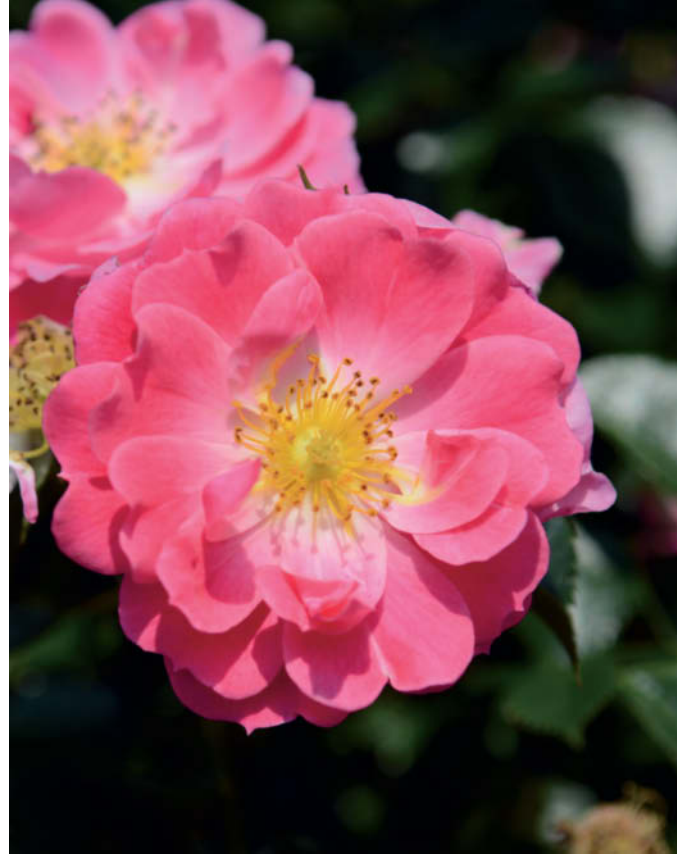
Top left-hand corner of the c't test scene

ISO 100 | 48 mm | f5.6 | 1/13 s





AF-S Nikkor 24-70mm f/2.8G ED | ISO 100 | 70 mm | f5.6 | 1/800s



AF-S DX Zoom-Nikkor 17-55mm f/2.8G IF-ED | ISO 100 | 55 mm | f5.6 | 1/1000s



Tamron SP 24-70mm f/2.8 Di VC USD | ISO 100 | 24 mm | f4 | 1/400s

All the lenses that we tested using the D7100 produced equally good results and we were unable to find any significant differences in our real-world test images

Sony 16-50mm f/2.8 DT SSM

The Lens: This lens has been on the market for more than two years and is very compact, in spite of its large maximum aperture. It is relatively lightweight at 580g (1¼lb), although this is partly because only the bayonet itself is made out of metal. Build quality is good, in spite of the prevalence of plastic in the design. The focus and zoom rings are nicely tactile and there is a switch for locking focal length at 16 mm.

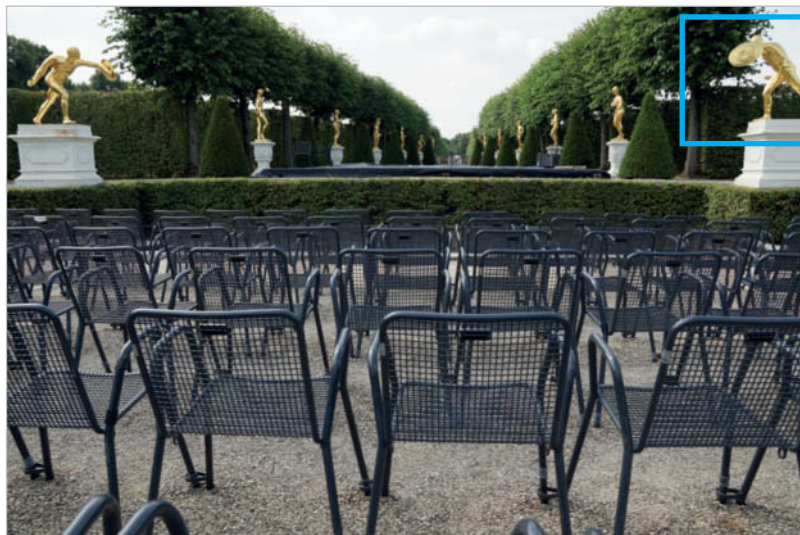
Test Results and Image Quality: Like all of our test lenses, the Sony shows weakness in the corners of the frame. At f2.8 and medium focal length, we measured just 900 line pairs, which is a meager 44 per cent of the potential maximum and the poorest value we recorded. Center resolution was a consistent 80 per cent throughout the entire zoom range, while edge resolution dropped off by 10-20 per cent. The only distortion we detected was some barrel distortion (about 1 per cent) at the wide-angle end. Vignetting came in at 0.8 stops wide open but was significantly less at smaller apertures. Chromatic aberration of 1.1 pixels at the long end was the worst we measured.

Our outdoor test shots showed good contrast and fine color and detail rendition, especially in the image center. Once again, our golden statue demonstrates the edge weakness that was a feature of the test lenses.

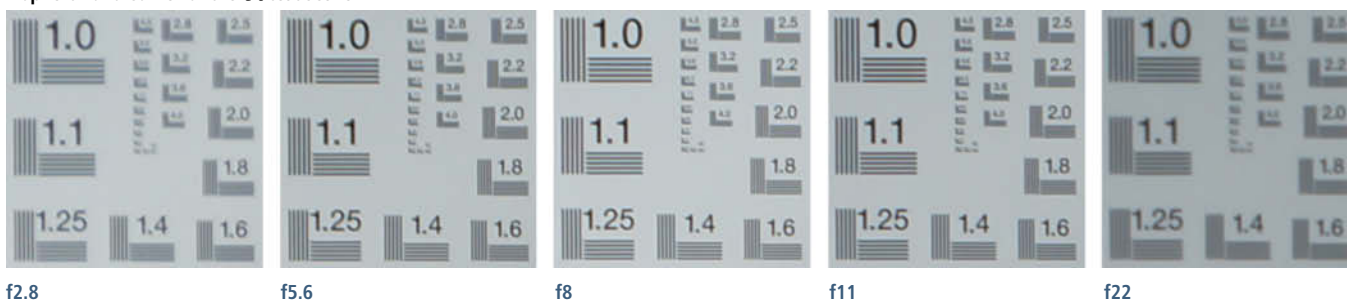


16-50mm f/2.8 DT SSM	
Aperture range / Number of blades	f2.8-f22 / 7
Focal lengths (35mm equivalent)	16-50 mm (24-75 mm)
Price (approx. US\$)	800
Measured at¹	maximum aperture / -2 stops
Center resolution	81% / 81%
Edge resolution	44% / 61%
Chromatic aberration	0.8 pixels
Distortion	-0.1%

¹ Using mid-range focal length



Top left-hand corner of the c't test scene



ISO 100 | 16 mm | f5.6 | 1/250s

Sony 24-70mm f/2.8 ZA SSM Vario-Sonnar T*

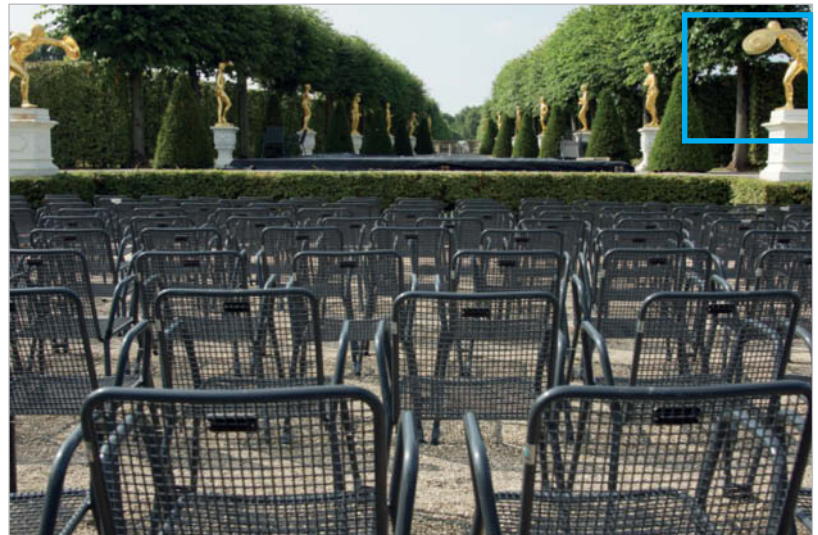
The Lens: This model has an unusual, rather cool-looking design that we found really attractive. At almost 1 kg (nearly 2¼ lb), it is one of the heaviest lenses we tested. Build and finish quality are very high and the metal lens barrel extremely robust. A Zeiss emblem underscores the high quality embodied in this lens.

Test Results and Image Quality: This lens produces much better quality results than those of its 16-50mm counterpart. Center resolution measured more than 80 per cent at maximum aperture and only fell off by 5-15 per cent at the edges. Stopping down delivered even more quality, even in the furthest corners of the frame. The only weakness we discovered was at maximum aperture at the telephoto end of the scale and there was virtually no distortion to speak of at any setting. Chromatic aberration measured a moderate 0.6-0.9 pixels and was difficult to detect visually in our test shots. The biggest surprise was the poor autofocus performance, which lagged behind all the other test models, especially at medium focal lengths and maximum aperture.

Outdoor contrast was much better than that produced by the 16-50mm model, especially at the edges of the frame. The sample image below shows that the Sony full-frame lens was one of the few we tested that was able to reproduce the detail in the statue with a high degree of realism. Our telephoto test shots turned out slightly less vivid than the wide-angle ones.

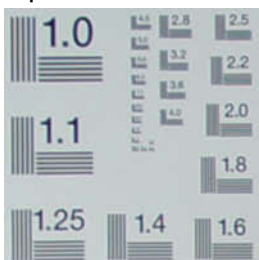


Sony 24–70 mm f/2.8 ZA SSM Vario-Sonnar	
Aperture range / Number of blades	f2.8-f22 / 9
Focal lengths (35mm equivalent)	38-112 mm (24-70 mm)
Price (approx. US\$)	2,000
Measured at¹	maximum aperture / -2 stops
Center resolution	81% / 81%
Edge resolution	71% / 76%
Chromatic aberration	0.6 pixels
Distortion	0%
¹ Using mid-range focal length	

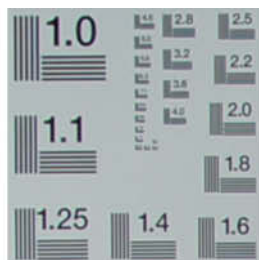


Top left-hand corner of the c't test scene

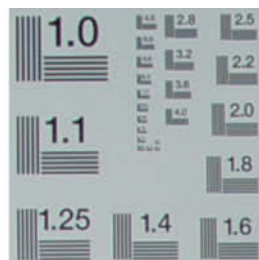
ISO 100 | 24 mm | f5.6 | 1/320s



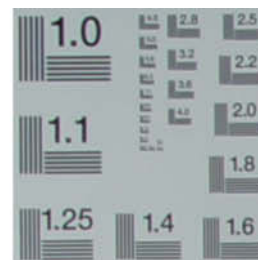
f2.8



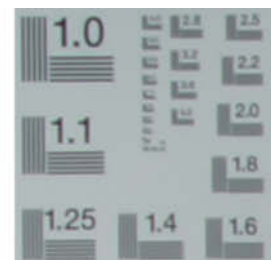
f5.6



f8



f11



f22

Sigma 24-70mm f/2.8 EX DG HSM

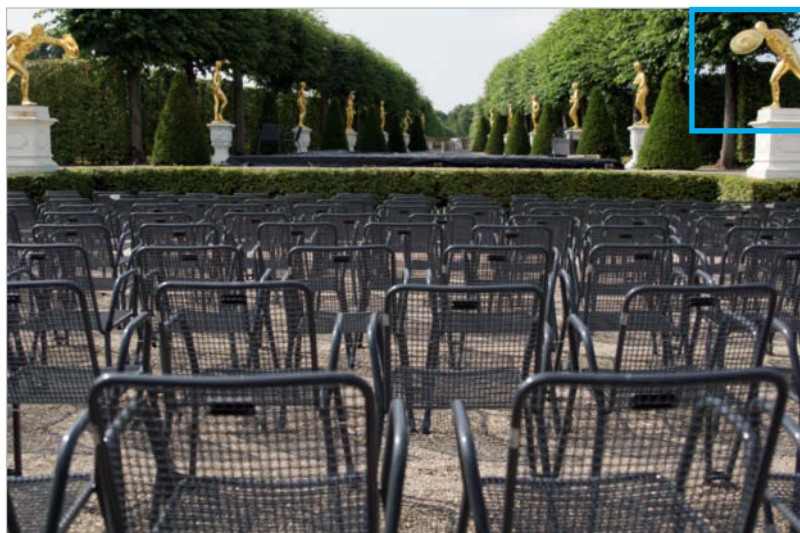
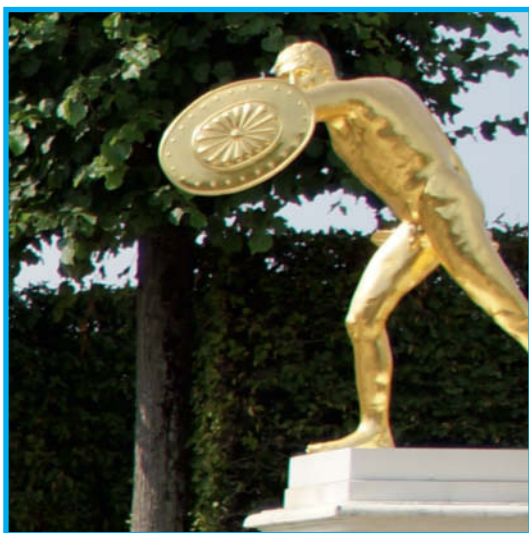
The Lens: Sigma manufactures cameras and third-party lenses for a range of camera models, and we tested the current full-frame standard zoom for Sony cameras. At 800g (more than 1¾lb), it is one of the heavier lenses we tested. Build quality is good, but incorporates rather too much plastic for a lens in this price bracket. It extends way beyond its otherwise compact dimensions at telephoto settings but is built well enough not to zoom unintentionally. Although it lacks a built-in stabilizer, this model does have an extremely quiet ultrasonic focus motor.

Test Results and Image Quality: The Sigma delivered its best overall image quality at the telephoto end, but resolution dropped off by more than 20 per cent in the corners at maximum aperture. Stopped down, it measured 1400 line pairs across the entire APS-C image circle and throughout the zoom range. Its distortion value of -2.6 per cent at the wide-angle end was very poor and chromatic aberration values of 1.3-1.5 pixels were worse than the others we recorded using the Sony camera. On the plus side, vignetting of just 0.4 stops at maximum aperture is a very good result indeed.

Our test images clearly show fringing at the edges of the frame and a loss of sharpness at wide-angle focal lengths. Generally speaking, the images it produced at the long end were more pleasing.

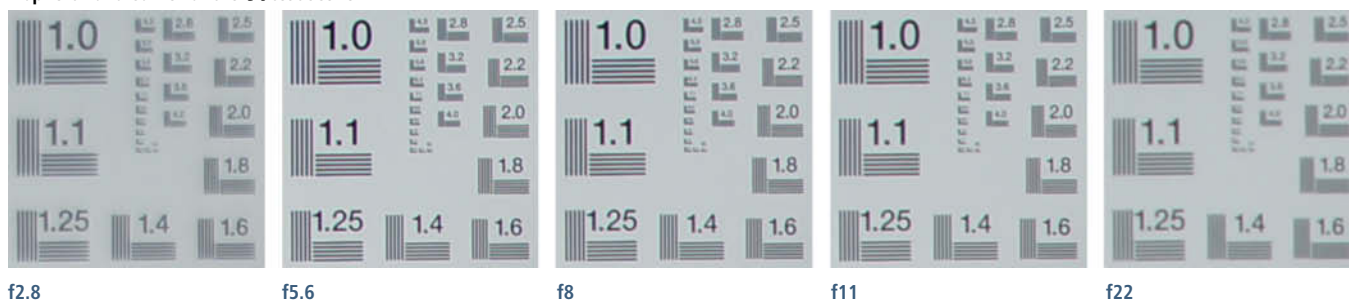


24-70MM f/2.8 EX DG HSM	
Aperture range / Number of blades	f2.8-f22 / 9
Focal lengths (35mm equivalent)	36-105 mm (24-70 mm)
Price (approx. US\$)	900
Measured at¹	maximum aperture / -2 stops
Center resolution	78% / 81%
Edge resolution	62% / 74%
Chromatic aberration	1.3 pixels
Distortion	-0.3%
¹ Using mid-range focal length	



ISO 100 | 24 mm | f2.8 | 1/1600 s

Top left-hand corner of the c't test scene





The Sony/Zeiss 24-70mm was the most expensive lens we tested and also produced the best contrast. The corresponding APS-C lens simply couldn't compete with this kind of quality.

ISO 100 | 55 mm | f2.8 | 1/4000 s

Conclusions

The third-party lenses we tested produced the biggest surprises, with Sigma, Tamron and Tokina all offering full-frame lenses that are great value, especially in view of the features they offer. Some even come with built-in stabilizers that are not part of the deal in their more expensive brand-name counterparts. If you don't put too much emphasis on the quality of the materials or the overall 'feel' of the product, these lenses make great alternatives and produced test values very close to those of their more costly competitors.

If build quality is your holy grail, you are probably better off sticking to lenses made by the same manufacturer as your camera, even if this does mean spending more money. The Sony/Zeiss lens is a case in point, offering superb quality at a very high-end price. Overall, the own-brand lenses we tested produced slightly better-quality images and, if you are not specifically looking to acquire a

full-frame camera, you are just as well off using a good-quality APS-C lens. You will simply have to decide for yourself whether that little extra sharpness and the heavy-grade feel of a full-frame 'original' are really worth the extra expense.

At the end of the day, there are no real arguments for using full-frame lenses with an APS-C camera. Full-frame lenses are larger and heavier than their small-sensor counterparts and, because optical errors can occur anywhere in the frame, even their larger image circle doesn't completely eliminate the optical anomalies and artifacts that affect smaller lenses.



The other thing to consider is that the extremely high resolution (and correspondingly small pixel size) of many of today's APS-C sensors make high demands on the optical qualities of a lens. Apart from the Nikon D800 'pixel monster', full-frame sensors give you more room for maneuver when composing an image and their larger pixels make it easier to get the best out of a lens.

Canon Overview

The APS-C EF-S 17-55mm shows significantly poorer image quality toward the edges of the frame, losing as many as 346 line pairs of resolution at maximum aperture. Stopping down improves the situation markedly. The 24-70mm avoids this problem entirely by offering a maximum aperture of f/4, which enables it to produce much more balanced results throughout the zoom range and



The Canon EOS 7D and the EF 24-70mm f/4.0L IS USM make a great team. In our test, the lens produced well-balanced images that were sharp all the way to the edges of the frame.

consistent sharpness right up to the edges of the frame. Nevertheless, the larger lens does not offer significantly better quality its APS-C opposite number.

The Tokina 17-35mm f/4 was our third-party Canon alternative and, apart from its rather obvious chromatic aberrations, proved to be a match for both brand-name lenses when used stopped down. The build quality of the Canon lenses is clearly superior to the Tokina with its slightly wobbly manual focus mechanism. The most convincing argument for the Tokina is its price, which is half that of its Canon full-frame equivalent and is even slightly less than that of the Canon-brand APS-C model we tested.



CANON RESOLUTION COMPARISON

Focal range	Wide-angle		Medium		Telephoto	
	Center	Edge	Center	Edge	Center	Edge
Maximum aperture						
EF-S 17-55mm f/2.8	1371	1092	1418	1247	1430	1084
EF 24-70mm f/4	1401	1303	1346	1152	1438	1268
Tokina 17-35mm f/4	1470	1201	1378	1125	1254	947
Stopped down						
EF-S 17-55mm f/2.8	1376	1322	1439	1355	1359	1282
EF 24-70mm f/4	1418	1354	1321	1362	1421	1350
Tokina 17-35mm f/4	1394	1323	1400	1284	1373	1136

Resolution was determined visually in units of vertical line pairs [lp/h]. The larger the value, the sharper the image.

Nikon Overview

The Nikon D7100 makes heavy demands on the lenses you use with it. Its 24 megapixels of resolution and lack of a low pass filter are features designed to produce extremely sharp images, but it will only do so if the lens you use is capable of resolving detail finely enough to capture it adequately using the relatively small pixels. We couldn't wait to find out how well the 10-year-old AF-S 17-55mm APS-C lens performed with the new, high-performance



The Tamron SP 24-70mm f/2.8 Di VC USD surprised us with consistently balanced detail rendition. This model rewards its user with sharp, high-contrast shots, even if lighting conditions are less than perfect.

camera. All the lenses we tested had problems retaining edge resolution, but our 'oldie' took the prize with nearly 700 line pairs of fall-off at its wide-angle setting. In spite of this shortcoming, the full-frame Nikkor delivers very good central resolution throughout the zoom range and loses very little sharpness in the middle and at the long end. It also shows very few other artifacts and aberrations.

The Tamron 24-70mm f/2.8 costs half as much as the equivalent Nikkor and produces



stopped-down results that are just as good or better. Its built-in stabilizer also performs very well in low light situations and the build quality is very good indeed.

NIKON RESOLUTION COMPARISON

Focal range zone	Wide-angle		Medium		Telephoto	
	Center	Edge	Center	Edge	Center	Edge
Maximum aperture						
AF-S 17-55 f/2.8	1782	1093	1621	1201	1405	958
AF-S 24-70 f/2.8	1803	1077	1734	1454	1644	1211
Tamron 24-70 f/2.8	1784	1339	1670	1314	1526	1090
Stopped down						
AF-S 17-55 f/2.8	1787	1006	1677	1402	1661	1049
AF-S 24-70 f/2.8	1771	971	1697	1548	1729	1473
Tamron 24-70 f/2.8	1795	1405	1810	1486	1782	1507

Resolution was determined visually in units of vertical line pairs [lp/h]. The larger the value, the sharper the image.

Sony Overview

Sony, too, raises the resolution bar with the 24-megapixel A77, and the performance we recorded for the 16-50mm APS-C bears witness to the challenge this presents. Resolution is extremely poor toward the edges at medium focal lengths and comes in at just 35 per cent (700 line pairs) in the upper right-hand corner at maximum aperture. However, stopping down does alleviate the situation somewhat.

The Zeiss Vario-Sonnar performs much better, as it should for US\$2,000! Edge weakness is negligible at wide-angle and medium focal lengths but increases toward

the telephoto end. Stopped down, the lens produces virtually no distortion or vignetting and autofocus only proved less reliable than manual focus at medium focal lengths.

The full-frame competition from Sigma is less than half the price but still performs almost as well in the resolution stakes, especially at the telephoto end, where it produces very even performance throughout the image circle. Stopped down, it performs well throughout the rest of the zoom range too. On the downside, there is obvious wide-angle distortion and visible chromatic aberration at all focal lengths. (tho/ssi)



Used with the SLT-A77, the Sigma 24-70mm produced decent results that weren't far behind those of the full-frame Sony lens, although we did notice some distortion and chromatic aberration.

SONY RESOLUTION COMPARISON

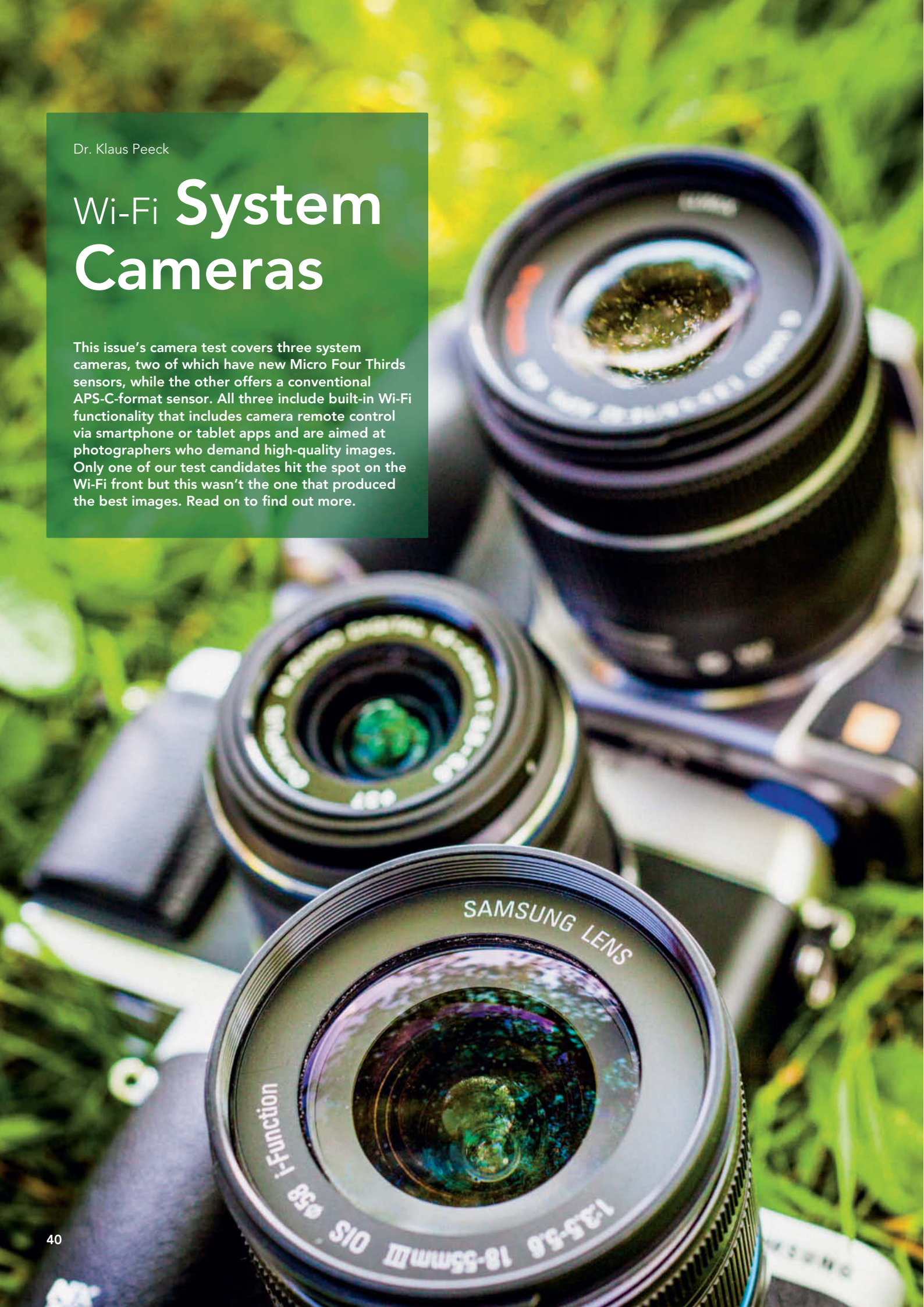
Focal range Zone	Wide-angle		Medium		Telephoto	
	Center	Edge	Center	Edge	Center	Edge
Maximum aperture						
SAL 16-50 f/2.8	1656	1245	1622	889	1599	1068
Zeiss 24-70 f/2.8	1646	1357	1621	1421	1596	1108
Sigma 24-70 f/2.8	1511	1137	1565	1236	1494	1330
Stopped down						
SAL 16-50 f/2.8	1676	1351	1631	1236	1606	1391
Zeiss 24-70 f/2.8	1639	1492	1621	1532	1618	1322
Sigma 24-70 f/2.8	1608	1468	1618	1484	1570	1484

Resolution was determined visually in units of vertical line pairs [lp/h]. The larger the value, the sharper the image.

Dr. Klaus Peeck

Wi-Fi System Cameras

This issue's camera test covers three system cameras, two of which have new Micro Four Thirds sensors, while the other offers a conventional APS-C-format sensor. All three include built-in Wi-Fi functionality that includes camera remote control via smartphone or tablet apps and are aimed at photographers who demand high-quality images. Only one of our test candidates hit the spot on the Wi-Fi front but this wasn't the one that produced the best images. Read on to find out more.



Our test cameras this time around are the Olympus PEN E-P5 and Panasonic Lumix DMC-G6 Micro Four Thirds models and the APS-C Samsung NX300. Like its predecessor, the Panasonic looks rather like a slimmed-down DSLR, with its big grip and electronic viewfinder built into the top of the body. The other two cameras have no built-in viewfinder and are both wider and lower than the Panasonic. The Olympus has a relatively small textured plastic bulge on its front that serves as a grip of sorts and which can, for a fee, be swapped for a solid wood version that nicely sets off the camera's high-quality metal body.

The Panasonic looks cheap and 'plasticky' compared to the Olympus but is solidly built and has useful rubberized pads on its front and back that make it easier to hold. The front of the Samsung is covered in faux leather and has a nice-looking aluminum top plate. Both Micro Four Thirds cameras offer 16-megapixel resolution, while the Samsung's larger sensor ups the ante to 20 megapixels. The PEN is the only one of our test models to use sensor shift image stabilization, and its unique 'five-axis' system claims to be able to stabilize even the roughest lurches – a claim that was also borne out in our test. Both the Panasonic and the Samsung depend on appropriately equipped lenses for image stabilization, and both supplied kit lenses do the job perfectly well. The kit lenses provided with all three cameras are relatively modest wide-angle zooms with equivalent focal lengths of 28-80mm and

apertures that range from f3.5 to f5.6. We were very happy to see that Panasonic and Samsung (in some markets) supply a lens hood as standard.

In brightly-lit situations, the Panasonic benefits greatly from its built-in viewfinder, which enables the user to compose images and continue navigating through the camera's menu system, even when reflections make this impossible using the monitor. Compared with the flickery unit built into the previous model, the viewfinder in the G6 has been swapped for a much better 1.4-million-dot unit, providing a much clearer image, even if it does still sometimes suffer from banding. A sensor beneath the viewfinder window switches the viewfinder on automatically when you raise the camera to your eye and can also be programmed to automatically activate autofocus. The PEN E-P5 offers a simple optical viewfinder or the extremely expensive VF-4 shoe-mounted electronic viewfinder. The VF-4 costs US\$280 but offers almost 1.5× magnification, 2.4 million dots of resolution, built-in diopter adjustment and up to 90 degrees of tilt. There are no viewfinder options available for the Samsung.

All three cameras have articulated touch screen monitors. The PEN E-P5 and the NX300 allow only vertical tilt (90 degrees upward and around 45 degrees down), while the fully articulated monitor built into the G6 enables you to fold the monitor in to face the camera body,

Camera-based Wi-Fi

All three of our test candidates have built-in Wi-Fi functionality that can be used to control the camera and view the camera monitor remotely or transfer image files to other devices using a smartphone or tablet app. The Samsung implementation offers a choice of 2.4 or 5 GHz wavebands.

The wireless functionality offered by Olympus in the PEN E-P5 is limited to use with the proprietary Olympus Image Share app, which includes a rudimentary remote shutter release (that only works in 'iAuto' mode), a self-timer and touch-driven AF. Other functions include basic retouching tools and writing GPS data to image files.

Because the E-P5 has no NFC (near-field communications) module, it generates a QR code that, once scanned, is used to automatically configure the smartphone. In the case of problems making a connection, the camera can also display the appropriate Wi-Fi connection data in human-readable form.

The Panasonic and Samsung cameras have built-in NFC functionality, which automatically configures a wireless connection between the camera and a second device if you hold the two close together. You can also use conventional WPS functionality or enter a PIN to make a connection. Both cameras also enable you to use a wireless access point to transfer image files to a computer, social networks or to the cloud without the use of additional software. The Samsung even has a built-in e-mail client for direct sharing.

The NX300 can send captured images automatically to a smartphone in the background, and the 'MobileLink' function (accessed by setting the mode dial to 'Wi-Fi') allows you to transfer media files to and from your mobile device. You can also use the app to control the self-timer and flash settings, and choose a location for saving your images. Remote shooting is only possible in Program mode.

The Panasonic smartphone app completely eclipses the other two, offering manual, semi-automatic and program mode shooting, as well as the option to switch shooting modes remotely. You can adjust the aperture, exposure time and a range of other settings using virtual dials in the app interface, and there is even a stripped-down version of the camera's 'Quick' menu available. Alongside all this stills functionality, video capture can be controlled remotely too.

The Panasonic's remote live view displays most of the data shown on the camera monitor. New images are not transferred automatically to your device if you are using it as a remote control and you have to use the 'Play' button to access the camera's memory and transfer selected images. Our test camera crashed twice while attempting to make a connection in 'Wi-Fi Direct' mode and we were only able to reset it by completely removing the battery. Data connections for image transfer only are rather clumsy to set up and cannot be automated.



The Wi-Fi-based remote control functionality built into the Panasonic Lumix DMC-G6 is much more comprehensive than that offered by Olympus and Samsung



offering great protection when it is not in use. The drawback of this system is that you have to fold the monitor out sideways to alter its vertical tilt.

All three cameras use capacitive touch screen technology. The Olympus and Panasonic monitors both have about 1 million dots of resolution and provide stable color rendition, while the Samsung has a 768,000-dot AMOLED (active-matrix organic light-emitting diode) screen that tends to give images a green cast when viewed at an angle.

Our test cameras use between 21 and 35 AF zones or a movable spot mode to adjust focus and also offer touch-based autofocus controlled via the monitor. In addition to its conventional contrast AF functionality, the Samsung also offers sensor-based phase detection AF support and manual focus with the help of the 'MF Assist' monitor magnifier function. The Olympus offers an optional focus peaking display to help you attain precise manual focus.

All three models use an established range of exposure modes, including program, aperture priority, shutter priority, program shift and various specialized scene modes. The two Micro Four Thirds cameras offer four custom modes and both the DMC-G6 and the PEN E-P5 have a 60-second maximum exposure time as compared to the NX300's 30-second maximum. Shortest exposure times are 1/4000s (Panasonic), 1/6000s (Samsung) and 1/8000s (Olympus). The G6 and the NX300 have B (long exposure) settings of up to two and four minutes respectively, while the Olympus allows exposures of up to 30 minutes' duration, accompanied by the unique 'Live BULB' function that shows the accumulated result of such long exposures in real time on the monitor. There is also an optional live histogram display.

The PEN and the Lumix have built-in flash, while the Samsung relies on a fairly weak (supplied) accessory unit that also produces vignetting affects at close subject distances due to the proximity of the lens barrel. In contrast, the Olympus offers an unusually short flash sync speed of 1/320s and – unlike the Panasonic – excellent close-range flash performance. The Panasonic also scores well with its optical wireless flash control functionality that allows you to control three remote flash groups on four separate channels. The Olympus, too, offers optical wireless flash functionality – an option that is not available with the Samsung.

All three cameras use Li-Ion batteries, and Panasonic and Samsung also sell proprietary AC adapters. Though the AC adapter for the Samsung cannot be used with the camera powered on, limiting its use to simply recharging the camera, the AC adapter for the Panasonic allows the camera to be used for photographic work while the adapter is attached. The Olympus doesn't provide a constant battery level

indicator while the Samsung's indicator proved to be imprecise and gave us insufficient warning before the battery died.

Handling

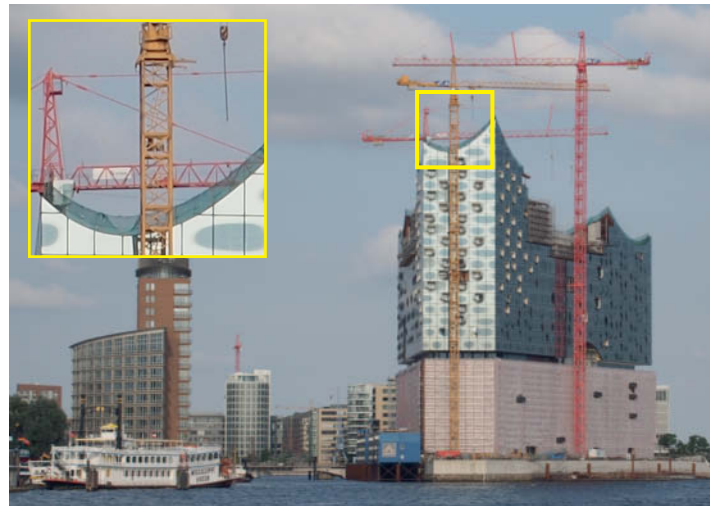
The Panasonic's DSLR-style body provided the best overall handling in our test, with plenty of easily reachable controls distributed over both sides of the camera back. The main mode dial is large but slightly stiff, and the function lever close to the shutter release can be used to zoom the lens and dial in exposure compensation values. Unfortunately, some of the buttons are too small and too flush with the camera body, making them too easy to press unintentionally. The main dial is also positioned too far to the right for easy adjustment using your thumb.

Panasonic's higher-end Lumix cameras are well known for their long menu pages that you can scroll through using the zoom lever, and the G6 augments this approach with touch-screen tabs. The familiar 'Quick' menu for fast access to major functions is included and you can also opt to display a single screen covering all the current main settings, which you can then adjust via touch control. At the expense of battery life, leaving the monitor info display permanently switched on provides a useful way to adjust camera settings, especially if you are using the viewfinder to frame and compose an image.

The Samsung's handling is just as flexible as the Panasonic's and is squarely aimed at touch screen operation. The NX300's monitor supports many of the smartphone-style gestures that users will be familiar with and pressing the 'Fn' button opens a main menu in which all major camera settings can be adjusted. Nonetheless, the camera can still be operated using the relatively narrow range of hardware buttons built into its body. The jog dial on the top plate can also be used to perform various actions including scrolling through menus. The 'iFn' button is designed for use with 'i-Function' lenses and displays a row of icons at the bottom of the monitor, which can then be used in combination with the focus ring to adjust various camera and lens settings.

The Olympus PEN E-P5 offers a huge range of settings that are packed into an 85-line (!) menu spread across 10 main tabs. You can navigate through these using either the arrow pad or the main and sub-dials. Olympus has decided to do without touch functionality for menu navigation and has limited the E-P5's touch control to focus, shutter release and 'live guide' functionality. There is no main status screen for direct adjustment of the main settings, which puts the Olympus behind the other test cameras with regard to overall ease of use.

Having said that, the E-P5 has a good range of user-configurable control buttons that work smoothly and precisely. The lever



surrounding the movie button can be used to switch quickly between various major exposure settings (exposure compensation, ISO, white balance, aperture value etc.), which can then be adjusted using the main and sub-dials.

At its maximum telephoto setting, the Olympus PEN E-P5 produced rather flat detail contrast

Hardware Performance

All three cameras performed very well in our real-world tests. The Olympus, with its extremely fast autofocus, was the most agile, even in poor lighting conditions. The Panasonic only reached its full potential speed in good light and the Samsung came in a definite third under all conditions, taking up to twice as long as the others to focus, in spite of its phase detection sensor elements.



The live view images provided by the Lumix and the NX300 are slow to adjust in low light, while the Olympus produced an image that was much easier to follow. All three cameras offer effective image stabilization technology, although the Olympus 'five-axis' approach was generally the most effective.

Burst mode worked fine in all three test models, although the buffers in the Samsung and the Panasonic filled up after just five and seven images respectively in RAW shooting mode. In Large JPEG mode, the Panasonic captured as many as 100 images in a single burst, while the Samsung threw in the towel after just 13.

Image Quality in the Real World

Image quality, too, was of consistently high quality, with none of our test candidates producing any serious exposure anomalies in any of our varied outdoor test situations. All three rendered colors faithfully and only the Samsung showed a slight tendency toward cool colors when used with standard exposure settings.

Considering the relatively modest quality of the kit lenses we were using, the resolution results were all very good. The Samsung was the clear leader in this respect, followed by the Panasonic and the Olympus, which regularly produced rather flat-looking images at all focal lengths.

The Olympus also tended to produce more diffusion artifacts than the other two cameras (possibly because of its lack of a lens hood), but – along with the Panasonic – produced good edge sharpness. The Samsung's 3:2 aspect ratio helped to put it firmly in third place in this respect. Panasonic and Samsung obviously have chromatic aberration under better control than Olympus.

All three cameras produced balanced Full HD video results that mirrored their stills quality characteristics. Focus tracking wasn't always



ISO 200 ISO 800 ISO 3200 ISO 12800

Detail enlargements of images shot at the harbor in Hamburg, Germany using the Panasonic Lumix DMC-G6

WI-FI SYSTEM CAMERAS: TEST RESULTS, PART 1

	Sensor resolution [lp/h]	Relative center resolution (ISO 100, wide-angle) in %	Center resolution (ISO 100) [lp/h]	Center resolution (ISO 400) [lp/h]	Center resolution (ISO 1600) [lp/h]	Center resolution (ISO 3200) [lp/h]	Center resolution (ISO 6400) [lp/h]	Center resolution (ISO 12 800) [lp/h]	Center resolution (ISO 25 600) [lp/h]	Center resolution (ISO 25 600) [lp/h]
	better >	better >	better >	better >	better >	better >	better >	better >	better >	better >
Olympus PEN E-P5 with M.Zuiko 60mm f/2.8 ¹	1728	100 ⁴	1728 ⁴	1682	1541	1467	1515	1424	1134	
Panasonic Lumix DMC-G6 with Lumix 20mm f/1.7 ²	1728	98 ⁵	1688 ⁵	1631	1518	1473	1515	1389	1255	
Samsung NX300 with NX 30mm f/2.0 ³	1824	93	1704	1605	1414	1341	1250	1161	952	

WI-FI SYSTEM CAMERAS: TEST RESULTS, PART 2

	Signal-to-noise ratio [S/Nx] ISO 100	Signal-to-noise ratio [S/Nx] ISO 400	Signal-to-noise ratio [S/Nx] ISO 1600	Signal-to-noise ratio [S/Nx] ISO 3200	Signal-to-noise ratio [S/Nx] ISO 6400	Signal-to-noise ratio [S/Nx] ISO 12 800	Signal-to-noise ratio [S/Nx] ISO 25 600	Visual noise OECF20 ISO 100
	better >	better >	better >	better >	better >	better >	better >	< better
Olympus PEN E-P5 with M.Zuiko 60mm f/2.8 ¹	63 ⁴	56	45	38	27	21	16	0.9 ⁴
Panasonic Lumix DMC-G6 with Lumix 20mm f/1.7 ²	63 ⁵	45	39	34	22	13	10	0.9 ⁵
Samsung NX300 with NX 30mm f/2.0 ³	95	55	44	38	28	19	13	0.7

¹ AF measurements made with an M.Zuiko 12-50mm f/3.5-6.3
² AF measurements made with a Lumix 14-42mm f/3.5-5.6 OIS
³ AF-Measurements made with an NX 18-55mm f/ 3.5-5.6 OIS

⁴ Measured at the lowest level of ISO 200 (without 'Low-light ISO')
⁵ Measured at the lowest level of ISO 160

Resolution was determined visually in units of vertical line pairs [lp/h]. The higher the value, the sharper the image. The results listed were recorded using hardware available in Europe. Results may vary for lens and/or camera versions available in other territories.

as precise as we would have liked, and the kit lenses we tested were generally too loud and their zoom actions not smooth enough for effective video capture.

... and in the Lab

Under lab conditions, our test cameras produced slightly different results from those we captured in the field, and you can check the differences yourself in the sample images that we have included on this issue's free DVD. Under these conditions, the Olympus produced the best detail rendition, and even managed to accurately reproduce the texture in the black cloth in the center of our test scene. Both the other cameras' processing engines smudged these details, even at ISO 100. Generally, the Olympus produced good details for a camera with a 16-megapixel sensor, although overall sharpness was best with the lens stopped down. The same is also true of the other two cameras, with the Samsung showing a stronger loss of sharpness toward the bottom of the frame. The Olympus produced bright, slightly warm colors with slightly variable white balance, while the Panasonic captured accurate but slightly low-key colors with a slight tendency to overexposure. The Samsung, too, recorded accurate colors but underexposed consistently, giving its images a slightly matte look. At the end of the day, it was the Olympus that produced the most balanced overall exposure results.

As far as noise is concerned, all three cameras produced acceptable results. Both Micro Four Thirds cameras suffer obviously from the high pixel density of their smaller sensors, although the Samsung wasn't really able to pull ahead in spite of its larger sensor. All three are only

capable of delivering clean results up to ISO 400 and show obvious texture fall-off and general softness from ISO 800 onward, making this the limit for passable 100% viewing on a monitor. Full-screen views were generally OK up to ISO 3200, although at this level, the Samsung smudges some details and the Olympus shows a lack of visible texture and unnatural-looking increases in contrast. The Panasonic, on the other hand, frays some edges and produces 'dirty' black tones, although only begins to really lose detail at ISO 6400.

Conclusions

These three cameras represent a potent combination of small size, interchangeable-lens flexibility and very good image quality. Out there in the real world, the Samsung delivers the best results straight out of the box, especially with regard to sharpness and detail rendition, although the kit lens doesn't produce great results right into the furthest corners of the 3:2 frame. From its position as an experienced manufacturer of smartphones, Samsung has produced the most well-thought-out and effective touch control system of our three test cameras but hasn't neglected the continuing need for conventional button-driven control. Combined with its sensibly limited range of settings and the useful 'iFn' functionality, the Samsung outdistances the other two in the handling stakes.

The Olympus scores well with its high-end retro look and well-finished metal body, as well as with its small overall dimensions and compact kit lens. It's lightning-fast autofocus is also a great feature and the only thing that really lets the PEN down is its complex and slightly confusing menu system.



Auto exposure in backlight: the Samsung NX300 (left) produced much cooler colors than the Panasonic Lumix DMC-G6

Contrast range /subject range ISO 100 [in f-stops] better ▶	Contrast range /subject range ISO 400 [in f-stops] better ▶	Contrast range /subject range ISO 1600 [in f-stops] better ▶	Contrast range /subject range ISO 3200 [in f-stops] better ▶	Contrast range /subject range ISO 6400 [in f-stops] better ▶	Contrast range /subject range ISO 12800 [in f-stops] better ▶	Contrast range /subject range ISO 25600 [in f-stops] better ▶	Real subject range [# of tonal values] better ▶	Color Checker SG & Δ E ISO 100 ◀ better
11 ⁴	10	9.7	9.3	8	7.3	6.7	254	10.9 ⁴
9.3 ³	8.3	9	8.3	7.7	7	6	256	10.9 ³
13	10	9	9	7.7	6.3	5.3	255	10.1

Visual noise OECF20 ISO 400 ◀ better	Visual noise OECF20 ISO 1600 ◀ better	Visual noise OECF20 ISO 3200 ◀ better	Visual noise OECF20 ISO 6400 ◀ better	Visual noise OECF20 ISO 12800 ◀ better	Visual noise OECF20 ISO 25600 ◀ better	Power up time [s] ◀ better	Shutter Lag Wide-angle > 1000 lx in live view [s] ◀ better	Shutter Lag Wide-angle at 30 lx [s] ◀ better
1.1	1.6	1.9	2.5	3.6	4.8	1.8	0.18	0.19
1.3	1.5	2	2.7	4.8	7.5	0.9	0.22	0.26
1.1	1.5	1.8	2.7	4.5	6.3	1.2	0.31	0.38

Real subject range represents the range of tonal values contained in an 8-bit rendition of a test image. Higher Signal-to-noise values indicate less disruptive noise. 'Visual noise' is a physiologically based judgment of how 'irritating' certain image noise artifacts appear to the viewer. The values are calculated based on the intensity, frequency and color of the perceived artifact. Values below 0.8 represent virtually noise-free images, values below 2 low-noise reproduction and those between 2 and 3 visible but acceptable noise levels. Values above 3 represent disruptive levels. Values of 5 and above represent extreme, unacceptable noise.

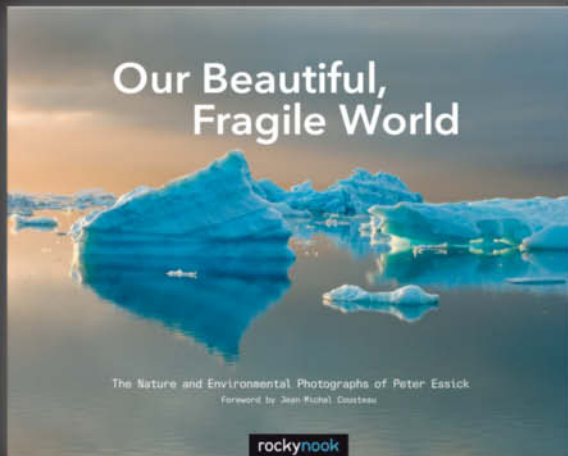
Even with its rubberized grips, the Panasonic Lumix DMC-G6 cannot disguise its plastic body, although the great overall build quality does compensate somewhat for the cheapness of the materials. We have already mentioned its ergonomic shortcomings. A big plus is the new, high-resolution electronic viewfinder, which allows you to hold the camera in a traditional eye-level position and continue composing images

in bright sunlight. Panasonic's comprehensive Wi-Fi-based remote control functionality is by far the best of this particular bunch and offers a fine range of pro-grade tools. The NFC (near-field communications) modules built into both the Panasonic and the Samsung make child's play of the increasingly important job of wireless file transfer between the camera and an Android-based smartphone or tablet. (pen)

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Our Beautiful, Fragile World features a career-spanning look at the images of photojournalist Peter Essick taken while on assignment for National Geographic magazine. This book showcases a diverse series of photographs from some of the most beautiful places in the world and documents major contemporary environmental issues, such as climate change and nuclear waste. Each photograph is accompanied by commentary on the design process of the image, Essick's personal photographic experiences, and informative highlights from the research he completed for each story.

*"...it's books like Peter Essick's **Our Beautiful Fragile World** that show us new discoveries, new knowledge, and new insights that will help heighten our understanding of the importance of the natural world to all living things, including ourselves."*

JEAN-MICHEL COUSTEAU

Our Beautiful, Fragile World

The Nature and Environmental Photographs of Peter Essick

November 2013, 124 pages, 10x8 Hardcover
US 34.95, CAN 36.95

WI-FI SYSTEM CAMERA OVERVIEW			
Manufacturer/Model	Olympus PEN E-P5	Panasonic Lumix DMC-G6	Samsung NX300
URL	www.getolympus.com/us/en	www.panasonic.com	www.samsung.com
Digitization			
Native resolutions (in pixels)	4608 × 3456, 2560 × 1920, 1280 × 960, 1024 × 768, 640 × 480 (4:3, with 16:9, 3:2, 6:6 or 3:4 selectable)	4608 × 3456, 3264 × 2448, 2336 × 1752 (4:3, with 3:2, 16:9 or 1:1 selectable)	5472 × 3648, 3888 × 2592, 2976 × 1984, 1728 × 1152 (3:2, with 16:9 or 1:1 selectable)
Sensor type, effective megapixels / Size / Self-cleaning	Live MOS, 16 / Micro Four Thirds (17.3 mm × 13.0 mm) / ✓	Live MOS, 16 / Micro Four Thirds (17.3 mm × 13.0 mm) / ✓	CMOS, 20 / APS-C (23.5 mm × 15.7 mm) / ✓
Image format(s) / Compression rates / Video format	RAW, JPEG, RAW+JPEG / 4 / MPEG-4 H.264, AVI	RAW, JPEG, RAW+JPEG / 2 / AVCHD or MPEG-4 H.264	RAW, JPEG, RAW+JPEG / 3 / MPEG-4 H.264
Video: max. resolution [pixels], length (H.264), fps	Full HD 1080p, approx. 29 min, 30	Full HD 1080p, approx. 29 min, 50/60 (PAL/NTSC)	Full HD 1080p, 29 min 59 s, 60
Memory card type / average file size ³	SD(HC/XC) / 7.5 MB	SD(HC/XC) / 8.5 MB	SD(HC/XC) / 9.1 MB
Features			
Crop factor (35mm equiv.) / Lens mount	approx. 2× / Micro Four Thirds	approx. 2× / Micro Four Thirds	approx. 1.5× / Samsung NX
ISO settings	Auto (200 to max. selectable), (100) 200-25 600 in 1/3 or 1/1 increments	i-auto, Auto (Max. up to 12 800 selectable), 160-12 800 (25 600) in 1/3 or 1/1 increments	Auto (100-200/400/800/1600/3200), 100-25 600 in 1/3 or 1/1 increments
Shutter speeds [s] / Default flash sync [s]	bulb (max. 30 min.), 60-1/8000 / 1/320 (extern. 1/250)	bulb (max. 2 min.), 60-1/4000 / 1/160	bulb (max. 4 min.), 30-1/6000 / 1/180
Focusing / Image stabilizing	AF (one-shot, touch AF, continuous, tracking, face detection), MF / ✓ (Sensor shift)	AF (one-shot, touch AF, continuous, tracking, face detection), MF / ✓ (in-lens)	Hybrid AF (one-shot, touch AF, continuous, face-detection), MF / ✓ (in-lens)
AF areas / Focus assist lamp	35, 9-area group or 1 (35 positions) / ✓ (orange)	23, 5 or 6 (can be grouped) or 1 (1798-7752 positions) / ✓ (red)	21 (macro: 35) or 1 (247/105 positions, contrast/phase detection) / ✓ (green)
Metering: Matrix / Center-weighted / Spot	✓ (324 sectors) / ✓ / ✓	✓ (1728 zones) / ✓ / ✓	✓ (221 sectors) / ✓ / ✓
Programmed auto / Scene modes / Custom presets	✓ (with shift) / 23 / ✓ (4 custom presets)	✓ (with shift) / 23 / ✓ (4 custom presets)	✓ (with shift) / 14 / -
Exposure: Aperture priority / Shutter priority / Manual	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ / ✓ / ✓
Exposure compensation [EV] / Depth-of-field preview	±3 EV in 1/3, 1/2 or 1/1 increments / ✓ (via Fn button)	±5 EV in 1/3 increments / ✓ (via one of several programmable Fn buttons)	±3 EV in 1/3 increments / ✓ (via Fn button)
Bracketing: Exposure / WB / Focus / Interval timer / Sound	✓ / ✓ / - / - / ✓ / ✓ (16-bit, stereo, 48 kHz)	✓ / ✓ / - / - / ✓ (16-bit, stereo, 48 kHz)	✓ / ✓ / - / - / ✓ (16-bit, stereo, 48 kHz)
Self-timer / Continuous shooting speed (JPEG/RAW) ⁶	12 or 2 s or 1-30 s, 1-10 shots, 0.5-3 s interval / 9.1 fps, 23 shots; 9.1 fps, 19 shots	10 or 2 s or 3 shots / 6.7 fps, >100 shots; 5.9 fps, 7 shots	2-30 s / 7.7 fps, 13 shots; 7.7 fps, 5 shots
White Balance: Auto + Man. / Presets / Fine-tuning	✓ (2 custom presets) / 6 / ✓ (+ Kelvin)	✓ (manual: 2 presets) / 5 / ✓ (+ Kelvin)	✓ / 7 / ✓ (+ Kelvin)
Sharpness, Contrast, Saturation adjustable / Color spaces	✓ / sRGB, Adobe RGB	✓ / sRGB, Adobe RGB	✓ / sRGB, Adobe RGB
Viewfinder: Type / Magnification / Coverage / Eyepiece distance	- (optional optical or electronic) / - / - / -	electronic (1.4 million dots, eye sensor) / 0.7× / 100% / 17.5 mm (with adjustable diopter setting)	- / - / - / -
Monitor: Diagonal / Resolution [dots] / No. of brightness settings	3.0" touch screen (capacitive, vertically tiltable) / 1.1 million dots / 15 (+ color correction)	3.0" touch screen (capacitive, fully articulated) / 1 million dots / 7 (saturation, color and contrast adjustable)	3.3" AMOLED touch screen (capacitive, vertically tiltable) / 768 000 / 5 (color adjustable)
Live View / With AF using sensor / Dedicated sensors	✓ / ✓ / n/a	✓ / ✓ / n/a	✓ / ✓ / ✓ (Hybrid elements built into sensor)
Body material / Control panel / Auto monitor rotation	Metal / - / -	Plastic / - / -	Metal and plastic / - / -
4-way selector / Multi selector / Command dials	✓ (+ OK button) / 1 / 2	✓ (+ center button) / 1 / 1	✓ (4 buttons + OK) / 1 / 1
Flash guide number (meters) / Charge time / Connector	10 (ISO 200, built-in flash) / 3.3 s / ✓ (TTL shoe)	10.5 (ISO 160, built-in flash) / 4.5 s / ✓ (TTL shoe)	8 (ISO 100, accessory flash) ⁷ / 3.1 s / ✓ (TTL shoe)
Playback			
Multiple [# of images] / Zoom / Histogram	100, 25, 9 or 4 or calendar / ✓ (up to 14×) / ✓ (+ RGB)	30, 12 or calendar / ✓ (up to 16×) / ✓ (+ RGB)	40, 15 or 3 each with calendar / ✓ (up to 7.6×) / ✓ (+ RGB)
Connectors/Dimensions			
Power source	Li-Ion battery	Proprietary AC adapter, Li-Ion battery	USB charger, Li-Ion battery
Interfaces / A/V out / HDMI / Remote control	Wi-Fi, USB 2.0 / ✓ (+ accessory port) / ✓ (Type D) / ✓ (Wi-Fi + cable)	Wi-Fi, USB 2.0 / ✓ (+ Mic in) / ✓ (Type C) / ✓ (W-Fi + cable)	Wi-Fi, USB 2.0 / - / ✓ (Type D) / ✓ (Wi-Fi + cable)
Dimensions (W/H/D) / approx. weight ⁶ Body only / With test lens	122 mm × 69 mm × 37 mm / 420 g, 535 g	123 mm × 85 mm × 71 mm / 390 g, 550 g	122 mm × 64 mm × 41 mm / 335 g, 535 g
What's in the Box			
Manual / User guide	Quick start guide, PDF manual	Quick start guide, PDF manual	Quick start guide, PDF manual
Accessories	Li-Ion battery BLN-1 (7.6 V, 1220 mAh, 9.3 Wh), charger, body cap, shoulder strap, USB cable, kit lens and VF-4 viewfinder (if applicable)	Li-Ion battery DMW-BLC12 (7.2 V, 1200 mAh, 8.7 Wh), charger, body cap, shoulder strap, USB cable, kit lens (if applicable) with hood	kit lens (if applicable) BP1130 (7.6 V, 1300 mAh, 8.6 Wh), charger, body cap, flash shoe cover, accessory flash, shoulder strap, USB cable, kit lens (if applicable) with hood
Optional accessories	Memory cards, camera case, interchangeable lenses, microphone set, underwater housing and accessories, other PEN system accessories	Memory cards, camera case, accessory flash, Four Thirds adapter, AC adapter and DC coupler, cable remote release, accessory microphone, HDMI cable, other Panasonic system accessories	Memory cards, AC adapter, GPS receiver, camera case, accessory microphone, other Samsung NX system accessories
Software			
Included software (Platform)	Olympus Viewer 3 (Win/Mac)	PHOTOfunSTUDIO 9.2 PE (Win), SILKYPIX Developer Studio 3.1SE (Win/Mac)	Adobe Photoshop Lightroom 4 (Win/Mac) Samsung i-Launcher
Ratings			
Test images ¹ (c't test scene shot in daylight)	Evaluated with M.ZUIKO DIGITAL 14-42mm f/3.5-5.6 II R MSC	Evaluated with G Vario 14-42mm f/3.5-5.6 Asph. OIS	Evaluated with Samsung NX 18-55mm f/3.5-5.6 OIS i-Fn III
Color rendition / Exposure	⊕ / ⊕	⊕ / ○	⊕ / ○
Sharpness / Detail rendition	⊕ / ⊕⊕	⊕ / ⊕	⊕ / ⊕
Image noise / Other artifacts ²	○ / ⊕	○ / ⊕	○ / ⊕
Ease of use ⁴ / Printed manual	⊕ / ⊕	⊕ / ○	⊕⊕ / ⊕
Feature set ^{4,5} / Included accessories ⁴	⊕⊕ / ○	⊕⊕ / ○	○ / ⊕
MSRP: Body only / With kit lens (US\$)	1000 / 1100	650 / 750	- / 800
¹ Judged by eye on a calibrated monitor (applies only to these cameras and therefore not comparable with earlier tests) ² Sharpening and compression artifacts, moirés and axial and longitudinal chromatic aberrations ³ Averaged values, measured using largest native image size and best JPEG quality ⁴ In relation to cameras in a similar price range ⁵ Photographic features only ⁶ With battery and memory card ⁷ Accessory flash supplied			
⊕⊕ excellent ⊕ good ○ satisfactory ⊖ poor ⊖⊖ inadequate ✓ included - not included n/a not applicable			



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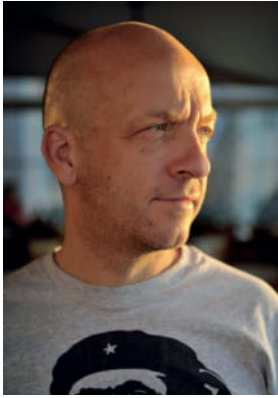
Olaf Ballnus

Portrait photography

In this workshop, professional portrait photographer Olaf Ballnus lets you in on some of his favorite tricks and strategies for capturing top-notch 'people pictures'. Look over his shoulder as he uses his unique skills to produce great location shots of stars and less well-known people, often using a bare minimum of props and equipment. He also invites us to look into his kit bag and tells us about the gear that has proved indispensable over the years.

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Olaf Ballnus is a dedicated portrait photographer. Most of his clients are high-circulation magazines, for whom he has photographed countless musicians, sports personalities and movie stars, but his job also involves using his skills to portray less well-known people and make them look just as special as his celebrity subjects. For an

effective portrait, you need a strong concept, the right gear for the situation, the right viewpoint and a wealth of technical tricks. "As long as there is an atmosphere of trust between the photographer and the subject, you can take interesting photos of anyone, even if you only have 15 minutes. Interest in the person I am portraying and emotional



A Portrait Photographer's Bag of Tricks

- 1 Sony Vaio VPCS12V9E (13.3 inch) notebook computer with 6 GB of memory
- 2 Nikon D700 DSLR with Multi Power Battery Pack and a 24-70mm f/2.8 Nikkor lens
- 3 Backup Nikon D700 DSLR with Multi-Power Battery Pack
- 4 Eizo Foris FS2331 23-inch monitor
- 5 Canon PowerShot G12 high-end compact and Canon WP-DC34 underwater housing
- 6 Nikkor 500mm f/8 mirror telephoto lens
- 7 Micro-Nikkor 45mm f/2.8D ED tilt/shift lens
- 8 Nikkor 70-200mm AF-S VR f/2.8G lens
- 9 Nikkor 16-35mm f/4 lens
- 10 Micro-Nikkor 105mm f/2.8 macro lens
- 11 Memory cards
- 12 Nikon Speedlight SB-400 flash (guide number 21)
- 13 Nikon Speedlight SB-800 flash (guide number 38)
- 14 Flash sync cable
- 15 Fujifilm X-E1 system camera and Fujinon 35mm f/1.4 XF R lens

exchange are much more central than technique," says Ballnus.

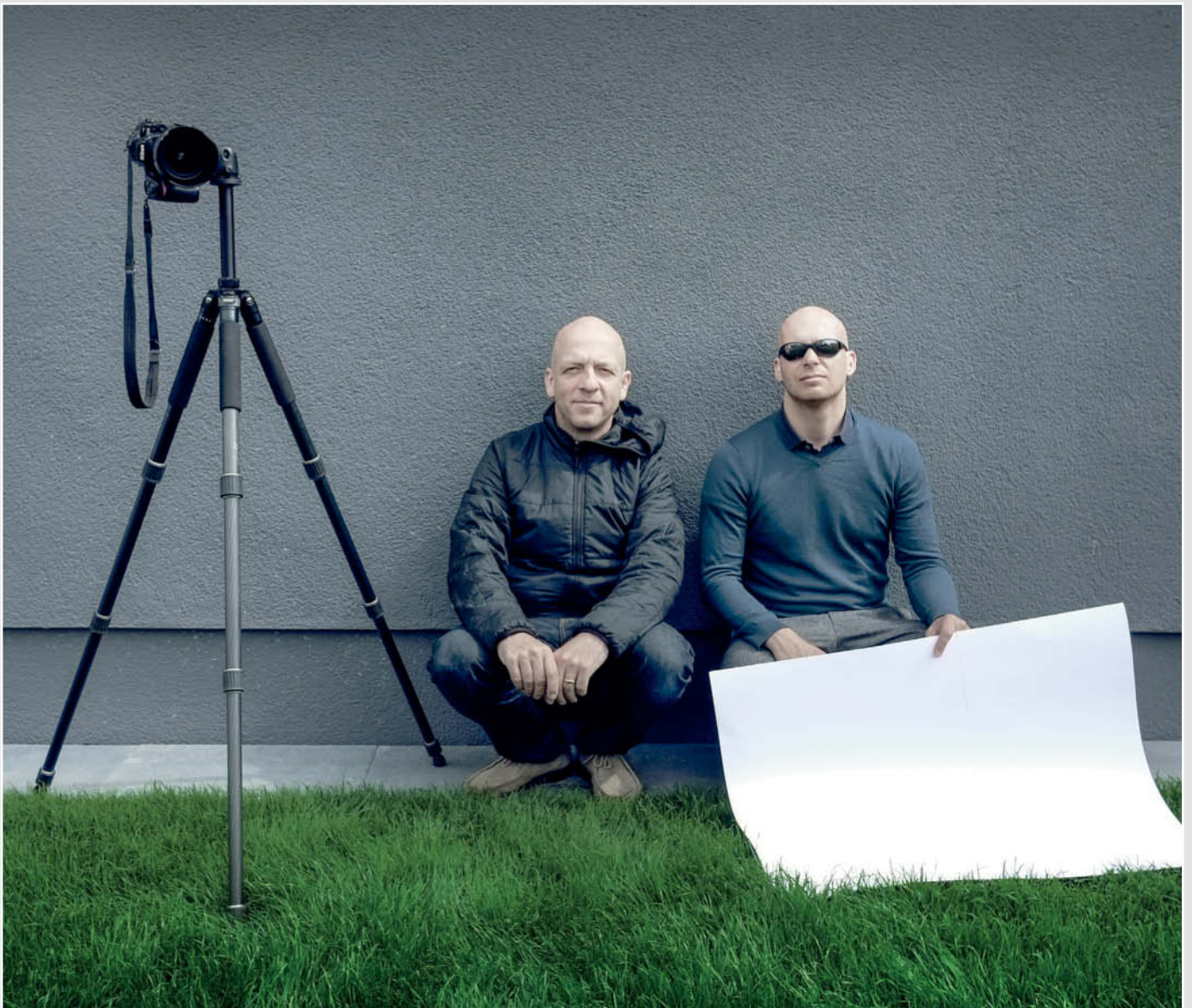
Nevertheless, technique still plays an important role that should never be underestimated – a notion borne out by the mound of gear that Ballnus uses regularly (see the previous page). We asked him which parts of his kit are absolutely indispensable for jobs

that require him to carry the bare minimum. "The Nikon D700 with the 24-70mm zoom, memory cards, a sun hat (essential with a haircut like mine), sunshine and a Nick Cave CD" was the wry answer, to which he added, "I also carry a backup D700 with a 50mm lens for emergencies. You never know when you'll need a reserve camera, and I recently had to

deal with a blocked shutter release and damage to two dropped lenses."

Many of Ballnus' images are created on location, so he often has to improvise to make the most of less-than-perfect conditions. The following pages go into detail on some of the techniques he uses, many of which are surprisingly simple.

Olaf Ballnus (left) and his assistant on location. Ballnus always carries a tripod and a monopod, although he rarely ends up using them. He prefers to move around on set to find the best perspective for the upcoming shot. Staying mobile also helps to keep the atmosphere on set relaxed.



Locations

In a studio, you can usually take time to prepare for a shoot and set up your lighting in advance, but, on location, you often have to shoot quickly in unfamiliar or unusual surroundings. Ballnus tells us that when he is shooting media personalities, the locations are often full of useless junk or

furnished with nothing more than a huge TV and a black sofa. Hotels and offices are no better as photoshoot locations either. He prefers to shoot in places where the history and charm of the location surprise and inspire him and help him develop his ideas." He often arrives at a location an hour or so

in advance to check out the area and scout for potential alternative scenery in case the shoot doesn't turn out as planned. Setting off early also helps to prevent the additional stress caused by traffic problems or finding somewhere to park.



Backstage in a TV studio with the actor and singer Peter Kraus – I taped a simple piece of checked fabric to the wall to change the background. I find the 'Gerband' brand the best tape to use, as it hardly ever leaves sticky marks when I remove it after a job. The tight crop using a 50mm lens completely eliminated the rather dull surroundings.

ISO 200 | 24mm | f6.0 | 1/30 s



ISO 200 | 50mm | f6 | 1/30 s



I like to use highly textured backgrounds, and brickwork is often just right. I took this shot of the musician Kim Frank outside the 'Hasenmanufaktur' ('Rabbit Factory') in Hamburg, Germany. The reflections in the glass in the smaller shot on the left, which was taken in Hamburg's Portuguese quarter, make it slightly less balanced.

ISO 1250 | 45mm | f5.0 | 1/1250 s



ISO 1250 | 45mm | f6.0 | 1/160 s

Using Depth of Field Effects

"I like to use apertures of f3.3 to f3.5 when I'm shooting with my 24-70mm zoom in daylight. Opening right up to f2.8 produces images that are generally not sharp enough, while apertures of f5.6 and less provide too much depth of field and too much

background sharpness for my taste." The sequence opposite demonstrates the effect of decreasing aperture on a portrait.

Olaf Ballnus says that optimum sharpness can often be found at apertures of around f8, although this is only a ballpark figure and

optical performance varies from lens to lens. See page 20 for a comprehensive lens test that covers a range of portrait-friendly optics.



For this portrait of the boxers Vitali and Vladimir Klitschko I chose a wide-open aperture to keep the composition interesting and give it extra depth.



ISO 200 | 35mm | f2 | 1/1600s



ISO 200 | 35mm | f4 | 1/800s



ISO 200 | 35mm | f8 | 1/100s



ISO 200 | 35mm | f22 | 1/13s

Playing with the degree of background sharpness is one of the simplest and most common ways to alter the look of a portrait photo. This sequence of shots of a model demonstrates the principle very well. Using an aperture of f2 keeps background detail nicely blurred, while decreasing the size of the aperture from shot to shot progressively increases the background sharpness. The disadvantage of smaller apertures is the longer exposure times they require.

Choosing the Right Focal length

50mm standard or 85mm short telephoto prime lenses make great portraiture tools that produce natural-looking images without the distortion produced their wide-angle counterparts. Some portrait specialists swear

by long telephoto lenses, citing framing flexibility without the need to change shooting positions as the main motivation for their choice. Fixed-focal-length lenses such as the 50mm and 85mm ones Ballnus

prefers mean that you have to keep moving around to find the right perspective. Alongside his prime lenses, his bright 24-70mm F/2.8 zoom is the lens he uses most often.



Wide-angle lenses are great for framing group shots, but be careful to position your subjects as close to the center of the frame as possible if you want to avoid producing unflattering distortion. This shot works very well in spite of the short focal length used to capture it.

ISO 400 | 16mm | f5.0 | 1/250 s



Telephoto lenses 'compress' the field of view, bringing the foreground and background visually closer together. The 500mm Nikkor mirror telephoto I used for this shot of the blind marathon runner Henry Wanyoike and his guide Joseph Kibunja made the giraffe appear much closer than it really was. This shot was captured during filming for the award-winning documentary *Gold – You Can Do More Than You Think*.





ISO 1000 | 16mm | f4 | 1/640s



ISO 1000 | 20mm | f4 | 1/640s



ISO 1000 | 28mm | f4 | 1/640s



ISO 1000 | 48mm | f4 | 1/640s



ISO 1000 | 70mm | f4 | 1/640s



ISO 1000 | 190mm | f4 | 1/640s

This sequence demonstrates how different focal lengths can affect the look of an image by altering the framing and perspective. I generally prefer to use 'standard' focal lengths of around 50mm for my portrait shoots.

Natural Light

Ballnus is an early riser, especially in summer: "I really like shooting portraits at around five or six in the morning in summer. If I have the luxury of planning a day's shoot myself, I prefer to shoot indoor scenes or sort the photos I have already taken in the

middle of the day. Then I can wait for the wonderful light of dusk between about six and seven in the evening to continue shooting portraits." Online tools like stardate.org make it relatively simple to find out when sunrise, sunset and the 'blue hour'

will occur at your chosen location. Ballnus likes to squeeze as much as possible out of the ambient light before resorting to artificial light sources, often using much higher ISO values than normal, as in the shot opposite.



I used no artificial light at all for this portrait of the actress Sibel Kekilli, shot in Istanbul. The cool ambient light was perfect for the mood and was so bright that I was able to shoot handheld at ISO 100.

ISO 100 | 50mm | f3.0 | 1/320s



Unwanted shadows can be problematic in portraits shot in bright sunshine, but handheld reflectors provide a simple way to attenuate the effect. This photo is part of a sequence about life on the North Sea island of Langeness.

ISO 200 | 50mm | f3.0 | 1/3200s



For this shot of TV chef Sarah Wiener, I increased the sensitivity setting all the way up to ISO 1000 to take advantage of the pleasing ambient light. Today's high-end, noise-reduced DSLRs make such high ISO settings much less of a problem than they used to be.

ISO 1000 | 29mm | f3.0 | 1/80s

Using Flash

If possible, Ballnus prefers not to use built-in flash or a flash unit attached directly to the camera's accessory shoe. He has a couple of simple tricks to get better flash results and says photos shot using direct, frontal flash often look 'cheap', whereas a flash sync cable or

remote release can cost as little as US\$30 and allows you to position your flash off-camera, giving you much more creative flexibility. Pro photographer Tom Ang describes the experience of using freely movable, off-camera flash as "intoxicating". Ballnus also likes to use

colored foils to alter the effect of the light his flashes produce: "Colored foils give flash photos a much more personal feel. I like to experiment and have found, for example, that shooting using LEE 105 Orange foil gives photos a really attractive warm look."



Using remote flash is a great way to produce unusual images (see opposite). I also like to attach colored foil to my flash to give the light it produces a slight tint.



Holding your hand in front of the flash during an exposure is a great way to produce unusual flash effects like the one shown on the left

ISO 640 | 24mm | f3.0 | 1/30 s



This shot was captured using just the ambient artificial light

ISO 1000 | 50mm | f3.0 | 1/30 s



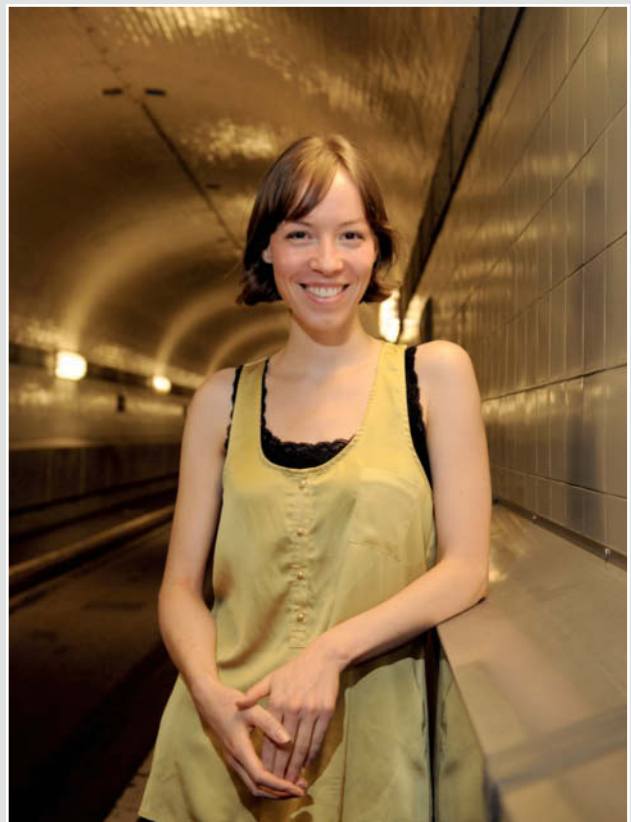
This shot was captured using the flash unit built in to my Nikon D700

ISO 2000 | 45mm | f4 | 1/100 s



Here, I lit the subject from above using a handheld Speedlight SB-400 flash (without colored foil)

ISO 2000 | 48mm | f4 | 1/100 s



This shot was lit like the one on the left, but this time with an orange foil covering the flash

ISO 2000 | 48mm | f4 | 1/100 s

Shooting in Black and White

Black and white photos still fascinate many photographers. Many subjects simply look more spectacular if captured in monochrome, and removing the color element is a clever move when it comes to giving your images more impact. “Black and white is often a great solution in mixed-light situations or when the colors in the subject

and the surroundings clash,” says Ballnus. Shooting successful black-and-white photos involves making a composition less complex while underscoring the shapes and forms rather than the colors themselves. Pro photographer Michael Freeman has described how a lack of color influences image composition, shifting the emphasis

from color to tonal contrast and the outlines and graphical forms within the frame. This effect is particularly clear in the portrait opposite. In spite of the obvious allure of monochrome, it only plays a minor role in commercial photography. Ballnus receives just “one or two” requests a year for black and white work.



This shot of members of the band *Beautiful F***ing Sabine* in their ramshackle rehearsal studio is much more effective in black and white

ISO 2000 | 24mm | f3.0 | 1/13 s



Black and white is often a good choice for portraits of distinctive individuals like musician Rita Marley



I like to use clear lines like those found in door and window frames to give my images structure. Using black and white in this shot of the actress Hannelore Hoger further emphasizes the clarity of this approach.

Developing Ideas

Ballnus thoroughly researches each portrait project before starting a shoot: "I always try to gather as much information as possible about the person or story involved. This gives me a stronger basis for developing ideas for the shoot. I'm always taking notes and making sketches, and I can refer back to my personal

archive of ideas when an appropriate situation comes up."

Celebrity portraits are, of course, the most intense jobs. "The shoot with soccer coach Juergen Klopp accompanied a magazine article on his terrific abilities as a motivator, and I had already formulated the 'tearing up

trees' idea before we began." Always aim to be flexible and be prepared to allow unplanned events to influence a shoot. For example, in the shots of author and ethnopharmacologist Christian Raetsch, his cat played an interesting spontaneous role in the session.



A session comes close to perfect if everybody plays their part and has fun turning the photographer's ideas into reality. This happened in this shot of soccer coach Juergen Klopp, who claims to want to "tear up trees" with his team.

ISO 100 | 38mm | f5.0 | 1/80 s



Sometimes, simply switching from portrait to landscape format gives a shot a completely different atmosphere.

ISO 200 | 7 mm | f4 | 1/30 s



ISO 200 | 27mm | f4 | 1/30 s



This scene, captured in Goa, India, was perfect for playing with the contrast between blur and sharp details

Shooting Sequences and Using Props

When preparing a shoot, Ballnus always thinks about bringing along props such as a sailor's jersey, artificial blood or a piece of patterned fabric for a background. "If I'm working with a suitable subject, I love to introduce bizarre and offbeat elements into an image. Bar owner Joerg Meyer (see opposite) was just such a subject and his bar is full of

architectural and decorative details that create a great atmosphere for a shoot." Props often add spice to a portrait, and emphasizing selected details in the subject can also help to give an image extra punch, as in the sequence below.

The photos below were all shot within a very short space of time. Herlinde Koelbl

(herlindekoelbl.de) takes a very different approach, portraying powerful politicians in exactly the same pose at intervals of several years. The changes that power can make to a person's appearance over time can be quite astonishing (sea)



Sequences of images often make an interesting way to show multiple facets of a subject's character, as shown here in a session I shot with nonagenarian German politician Helmut Schmidt. Bringing tiny details like the wedding ring and the cigarette into sharp focus give this series its final polish.





Some jobs cry out to be pepped up using props typical to the person being portrayed. In this case, it was an obvious choice to introduce a cocktail (here, a gin basil smash) into this shot of Joerg Meyer, the owner of the *Le Lion – Bar de Paris* in Hamburg. **ct**

ISO 200 | 48mm | f5.0 | 1/50 s



Michael Jordan

GIMP

or Photoshop?

Adobe's new licensing model means that in future it will only be possible to rent their software products. This change has prompted many users to look for alternatives to Photoshop, and the open source GIMP package is high on many people's lists. We took a closer look at this powerful free tool.

There is no simple answer to the question of whether *GIMP* is a real alternative to *Photoshop*, as there are too many users with their own ideas and too many ways to use both programs to compare them directly. Whether a potential *GIMP* user already has experience using *Photoshop* also makes a difference: image processing beginners are bound to be less biased than old Adobe hands.

GIMP is available for Windows, Mac OS X, Linux and various other UNIX derivatives and can be downloaded for free from www.gimp.org. The current 2.8.6 version is included on this issue's free DVD. The current CC (Creative Cloud) version of *Photoshop* is part of Adobe's new rental-only licensing model and offers users the benefit of software that always contains the latest updates and improvements. At the moment, a *Photoshop*-only subscription costs US\$20 per month, while access to the entire range of CC (Creative Cloud) apps – including *Illustrator*, *InDesign*, *Dreamweaver* etc. – costs US\$50-75 per month, depending on whether you take out a monthly or yearly subscription. There are also special offers available for existing users who switch to a CC plan.

If you are interested in 3D image processing or work in a pre-press environment, then *Photoshop* is doubtless the more powerful and useful of the two programs. The disadvantages of *GIMP* are that working in Lab mode is only possible via a workaround and it doesn't offer the advanced Apply Image and Calculations functions that are available in *Photoshop*.

In view of these differences, *GIMP* is a less likely choice for imaging professionals, but can still be extremely useful for other groups of users. On the following pages, we investigate its strengths and limitations lie.

The User Interface

Experienced users will probably have an easier time than beginners getting used to the *GIMP* interface, and many tools and functions will appear familiar, even if their names are confusing at first.

Many of the menu entries and settings options are the same in both programs, which even have the same number of main menus. However, while *GIMP* has dedicated Colors and Tools menus, *Photoshop* tucks them away in various sub-menus. On the other hand, *Photoshop* offers dedicated 3D and Type menus that are not part of the main interface in *GIMP*. Generally speaking, Adobe's menus are more comprehensive than those offered by *GIMP*.

Both applications offer a range of standard keyboard shortcuts, although some have different functions. For example, Ctrl+D deletes a selection in *Photoshop* but duplicates the current image in *GIMP*. If you want to use both programs, it is a good idea to manually set the shortcuts you use most often so that they are identical in both programs.

Just as *Photoshop* has its own native PSD format, *GIMP* offers its own proprietary XCF format for saving layers, paths and text losslessly with 8-bit files. *GIMP* also supports output to JPEG and TIFF, although these formats have to be selected using the File>Export dialog.

The multiple windows that made up the standard interface in earlier versions of *GIMP* proved an insurmountable hurdle that put many potential and experienced users off further experimentation. Version 2.8 introduced the long-awaited single-window mode that makes editing images and managing multiple files much easier. Now,

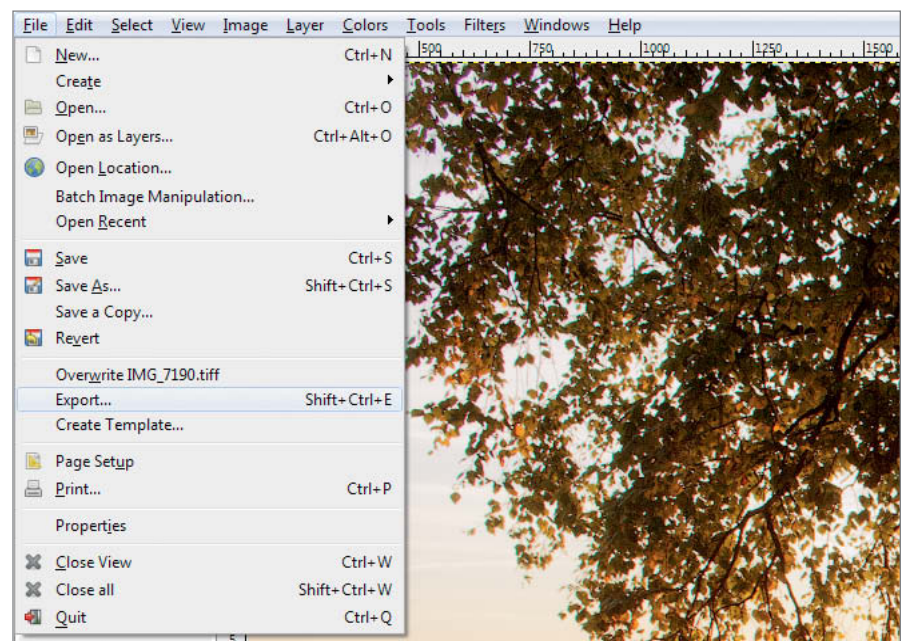
each open image has its own thumbnail located above the main image pane. Multi-window mode still has its advantages if you use multiple monitors, but single-window mode is the better option for single-monitor and notebook computing environments.

Layers

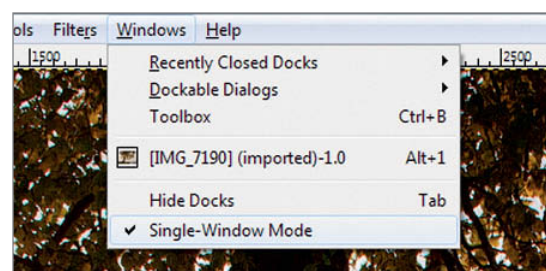
Layers functionality simplifies many aspects of the image editing process. Although not strictly necessary for performing basic adjustments to an image, layers are an indispensable tool if you want to merge multiple images into one or perform non-destructive editing steps, layers.

Layers offer a multitude of editing options and one of the most powerful is the use of blending (or 'blend') modes to merge the pixels of one layer with the corresponding pixels in another. The current version of *Photoshop* CC offers 27 different blend modes.

GIMP offers 21 blend modes with adjustable opacity just like their Adobe



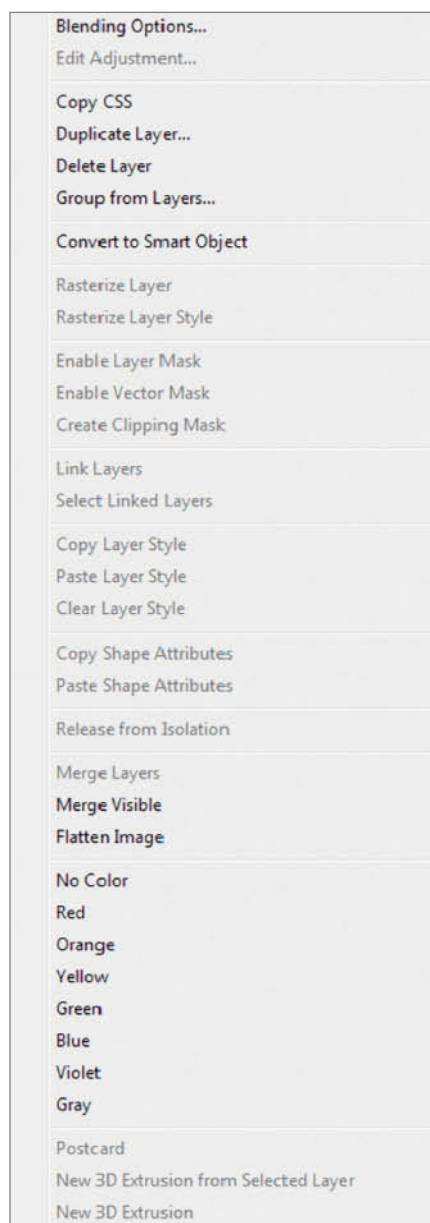
Files have to be exported to save them in conventional non-GIMP formats such as JPEG and TIFF



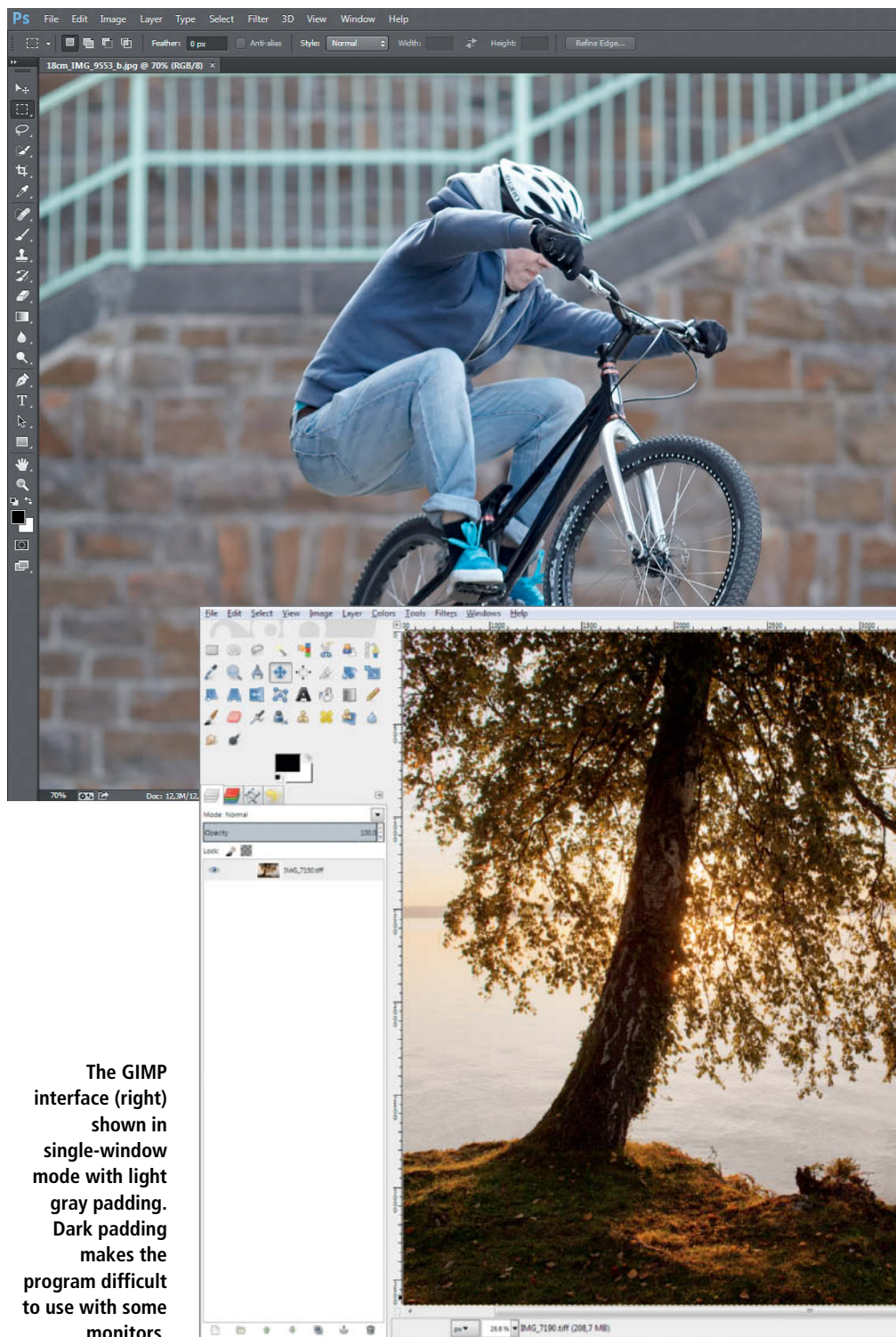
Single-window mode is not the default view and has to be selected manually

counterparts. *Photoshop* goes one better by offering the Layer Style dialog for fine-tuning blending operations by excluding predefined tonal ranges from individual channels, while *GIMP* offers no such sophisticated additional functionality.

The ability to insert a file as a new layer in an open image is often extremely useful, especially if you need to merge multiple files into a single HDR (high dynamic range) image. In *GIMP*, this is achieved using the File > Open as Layers command, whereas *Photoshop* uses the File > Place command. Multi-layer images opened this way retain their layers in *GIMP* but



Smart Filters and Smart Objects are *Photoshop's* way of providing non-destructive editing functionality



The GIMP interface (right) shown in single-window mode with light gray padding. Dark padding makes the program difficult to use with some monitors.

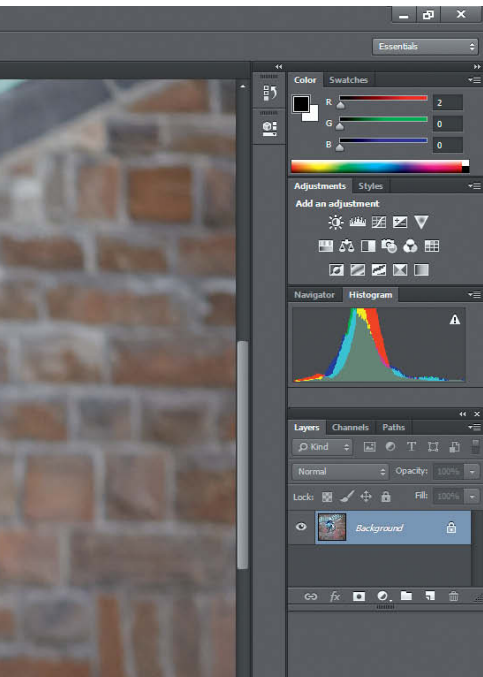
appear as a single layer in *Photoshop*. If you need to adjust individual layers in a placed image in *Photoshop*, you first have to convert the inserted image into a Smart Object.

Batch Processing

Nowadays, most photographers who need to process multiple images using the same settings use dedicated RAW converters that

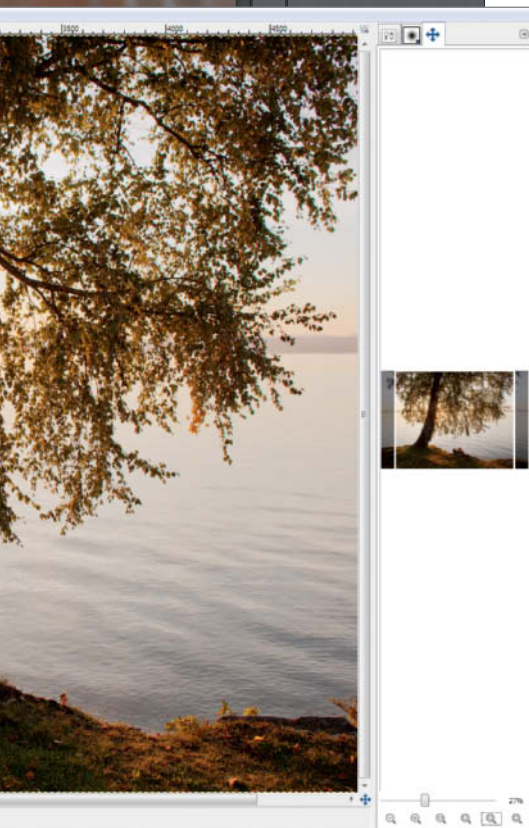
have effective built-in batch processing functionality, such as *Lightroom* or *Aperture*. This is often the case when photo sequences are shot under consistent lighting conditions – for example, using studio flash.

The *Batch Image Manipulation* plug-in supplied with *GIMP* enables you to apply identical changes to parameters such as size, cropping, rotation and color correction to multiple images at the click of a button.



The dark default interface in *Photoshop CC* gives it a professional look. The individual windows and panels can be arranged and docked as you please and each arrangement can be saved as a preset view for use with a specific task.

Automate > Create Droplet command simply asks you to select the Action(s) that the droplet should contain and the locations for saving the droplet and the images that result. Once a droplet has been saved, you can apply the Action(s) it contains by dragging images to its icon. This is a quick and practical way to customize batch processes.



Smart Objects

When Smart Objects were introduced with *Photoshop CS2*, it was the first time Adobe users had ever had the option of performing non-destructive processing directly from the *Photoshop* interface. Image editing suddenly became a whole lot more flexible, as adjustments made this way can be undone or tweaked at any time. *GIMP* does not offer non-destructive editing functionality or the adjustment layers that allow *Photoshop* users to apply Levels, Curves and other adjustments to single or multiple underlying layers.

RAW Conversion

Developing 'digital negatives' (i.e., RAW conversion) is one of the most challenging aspects of the digital photographic workflow. Portrait photographers need to optimize skin tones and product photographers have to find the best possible way to achieve realistic color reproduction. *Photoshop* includes the *Adobe Camera Raw (ACR)* conversion module, which can convert source images to 8- and 16-bit output files. The *UFRAW* conversion module supplied with *GIMP* can only create 8-bit output.

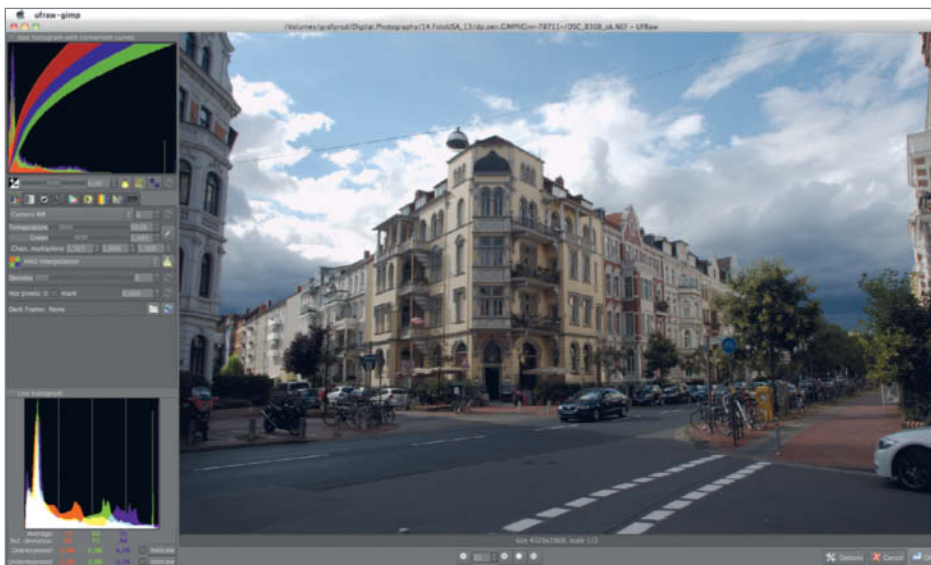
Both modules offer a wide range of options and leave little to be desired in the way of conversion flexibility. The *GIMP* module takes a rather more 'technical' approach and uses terms that require prior knowledge of RAW processing, for example when selecting the best interpolation method for a white balance adjustment. However, for technically minded users, this approach offers plenty of scope for making complex custom edits.

If you belong to the subset of users who rarely require editing functionality beyond that offered by RAW converters such as *Lightroom*, *Aperture*, *Capture One* and *iPhoto*, you probably won't need the powerful tools provided by *Photoshop CC* and you will most likely find that the range of editing options offered for free in *GIMP* is sufficient to cover your basic needs. If, however, you use your RAW converter to preserve image data only and prefer to use specialized software with a greater range of options for editing tonal and color settings, you will probably find that *Photoshop CC* is more up your street. Composited images always require separate, complex processing.

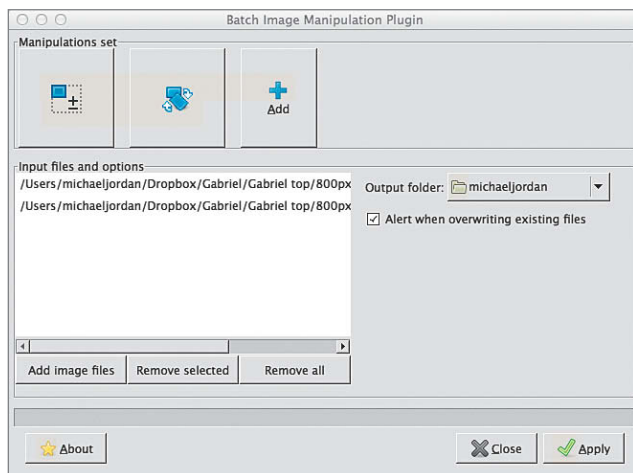
	Normal
Normal	Dissolve
Dissolve	Lighten only
Darken	Screen
Multiply	Dodge
Color Burn	Addition
Linear Burn	Darken only
Darker Color	Multiply
Lighten	Burn
Screen	Overlay
Color Dodge	Soft light
Linear Dodge (Add)	Hard light
Lighter Color	Difference
Overlay	Subtract
Soft Light	Grain extract
Hard Light	Grain merge
Vivid Light	Divide
Linear Light	Hue
Pin Light	Saturation
Hard Mix	Color
Difference	Value
Exclusion	
Subtract	
Divide	
Hue	
Saturation	
Color	
Luminosity	

The basic order of *Photoshop's* 27 blend modes is different from that of the 21 modes offered by *GIMP*

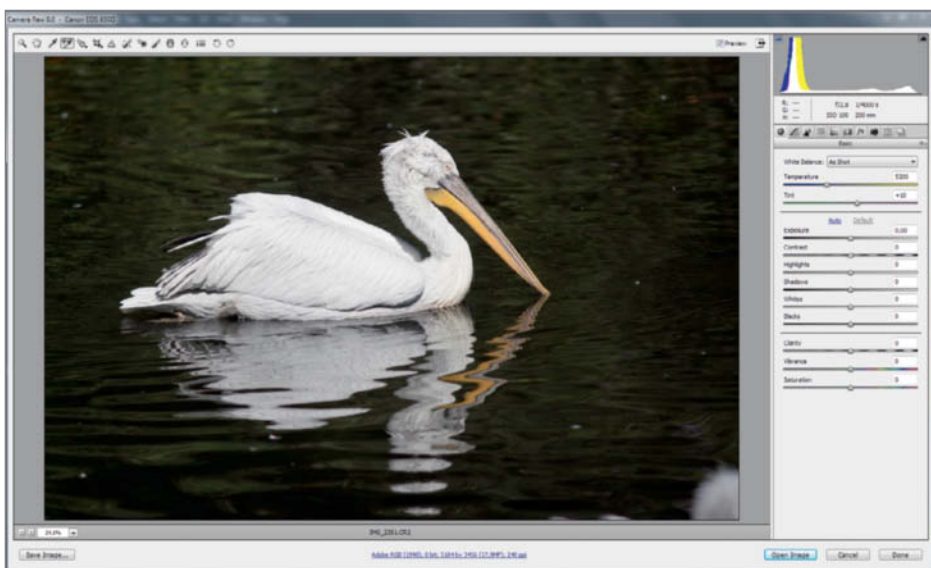
Photoshop offers much more comprehensive automation in the form of Actions, which allow you to record sequences of processing steps that can then be applied to a selected image. Actions can be halted at any time to allow you to fine-tune the current step and can also be saved as 'droplets' – micro-programs that can be applied to multiple images. You do not need any programming experience to create a droplet: the File >



The *UFRaw* module built into *GIMP* is rather 'technical' and only works in 8-bit mode



The *Batch Image Manipulation* plug-in provided with *GIMP* takes a much simpler approach, enabling you to adjust size, color and other image parameters for multiple images with a single click



Version 8.0 of the *Adobe Camera Raw* conversion module offers complete RAW processing functionality in a single easy-to-use interface

Conclusions

Is a bicycle tour a real alternative to overseas travel? Both provide a change of scenery and help you to unwind, but do so in very different ways with differing degrees of comfort. The question of whether *GIMP* offers a real alternative to *Photoshop* is similar.

Both programs enable you to process images digitally, and it really doesn't matter which you use to perform basic corrections to levels and tones or to sharpen the results. The same is true for selective adjustments to contrast, brightness and color.

Photoshop, with its Actions and 'droplet' functionality, offers distinct advantages when it comes to automating multiple recurring tasks while retaining the ability to intervene in the process and fine-tune the results where necessary.

On the other hand, *GIMP* offers a number of interesting and sometimes surprising tools whose effects can only be duplicated in *Photoshop* using multiple steps or workarounds. For example, the Filter > Combine > Filmstrip command uses a single click to insert multiple images into a frame that looks like a strip of analog negatives.

The overall look of the *GIMP* interface is slightly less cohesive than Adobe's offering, but this doesn't detract from its effectiveness or the quality of the results. Again, for the technically minded, *GIMP* presents an interesting, sometimes challenging, but always rewarding approach to digital image editing.

GIMP's strengths lie in its basic editing and simple retouching functions and in its comprehensive and effective print management module. If you only need the tools offered by *GIMP*, the results will be just as good as those *Photoshop* can provide. However, Adobe's tools still offer more options and sometimes simpler handling too.

While most imaging professionals will probably subscribe to the Creative Cloud model sooner or later, amateurs and semi-pro users no longer have the option of 'missing out' a particular upgrade to save costs or simply because a new version doesn't provide any relevant improvements. In future, anyone who wishes to continue using Adobe imaging products will have to decide whether they are worth a monthly investment of at least US\$20.

However, going back a few years, no-one would have believed how much people are now prepared to pay for their monthly mobile communication needs. Perhaps Adobe will come up with a prepaid model that only charges users for the time they actually spend using the software – until then, that old CS version or *GIMP* might just be all you need after all. (pen/keh) **ct**



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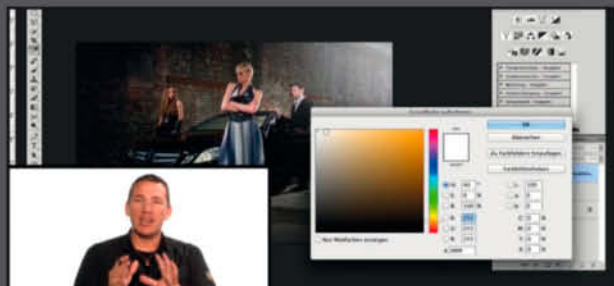


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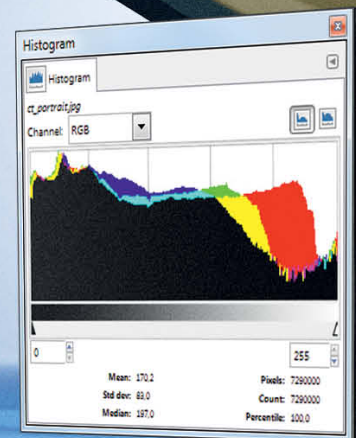
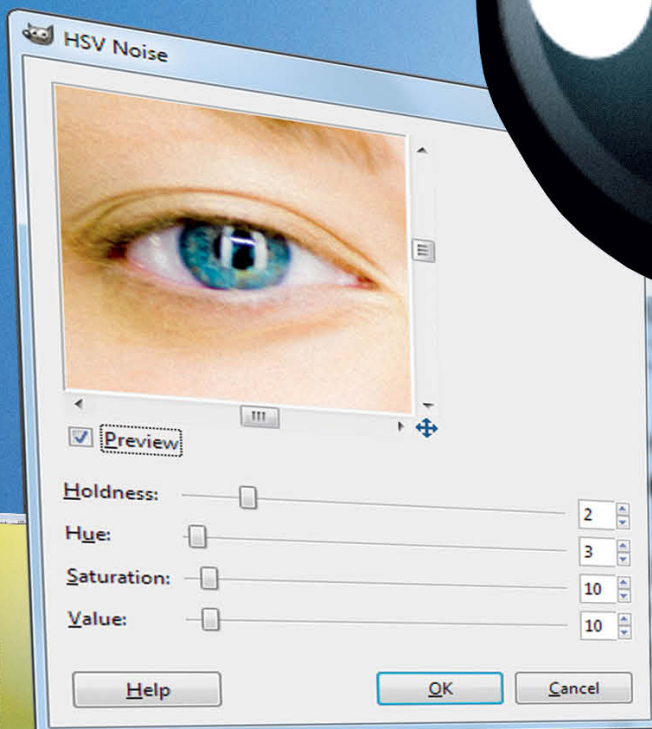
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Bernhard Stockmann

Editing in GIMP

For many photographers, Photoshop is still the image processing program that matters the most. However, since Adobe introduced its new subscription-only licensing model, many seasoned users have begun to experiment with the open source competition. In this article, Bernhard Stockmann uses hands-on examples to show just how capable GIMP has become.



There is no question that *Photoshop* remains the de facto standard image processing software for many imaging professionals. However, since the introduction of the new subscription-only licensing model, Adobe's largely unchallenged hold on the market has begun to crumble. Many users have been scared off by the new pricing structure and end up trying out *GIMP* sooner rather than later.

GIMP has been under constant development for more than 13 years and now includes many of the features requested by users. The latest version features the long-awaited single-window mode, which has been widely celebrated by the *GIMP* community. The latest Windows version 2.8.6

has been downloaded more than five million times in the last few months, and that figure doesn't even include the predecessor 2.8.4 and 2.8.0 versions or Linux and Mac builds.

As well as being entirely free (we have included the current version and a selection of plug-ins on this issue's free DVD), *GIMP* is also a highly versatile application. I have been using it professionally for more than seven years for Web design and for compositing images that I publish regularly at gimpusers.com.

The following pages provide an overview of the *GIMP* interface, an introduction to some of the most important tools and functions and a series of step-by-step portrait-editing tutorials.

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An Overview of the GIMP Interface

The GIMP interface is complex and contains a wealth of information and settings options. The new single-window mode (Window > Single-Window Mode) is an important addition for potential converts from Photoshop. The most important components of the GIMP program window are shown below.

Toolbox:
This is where you can select which tool you want to use to process your image. You can hide tools you use less often in the *Toolbox* section of the *Preferences* dialog. You can also select smaller icons under *Preferences > Theme > Small*.

Tool Options:
This is where you make the settings appropriate to the currently active tool.

Navigation Bar for Open Images:
You can scroll through open files using *Ctrl+Page Up/Page Down*. Individual images can be activated using *Alt+number key*.

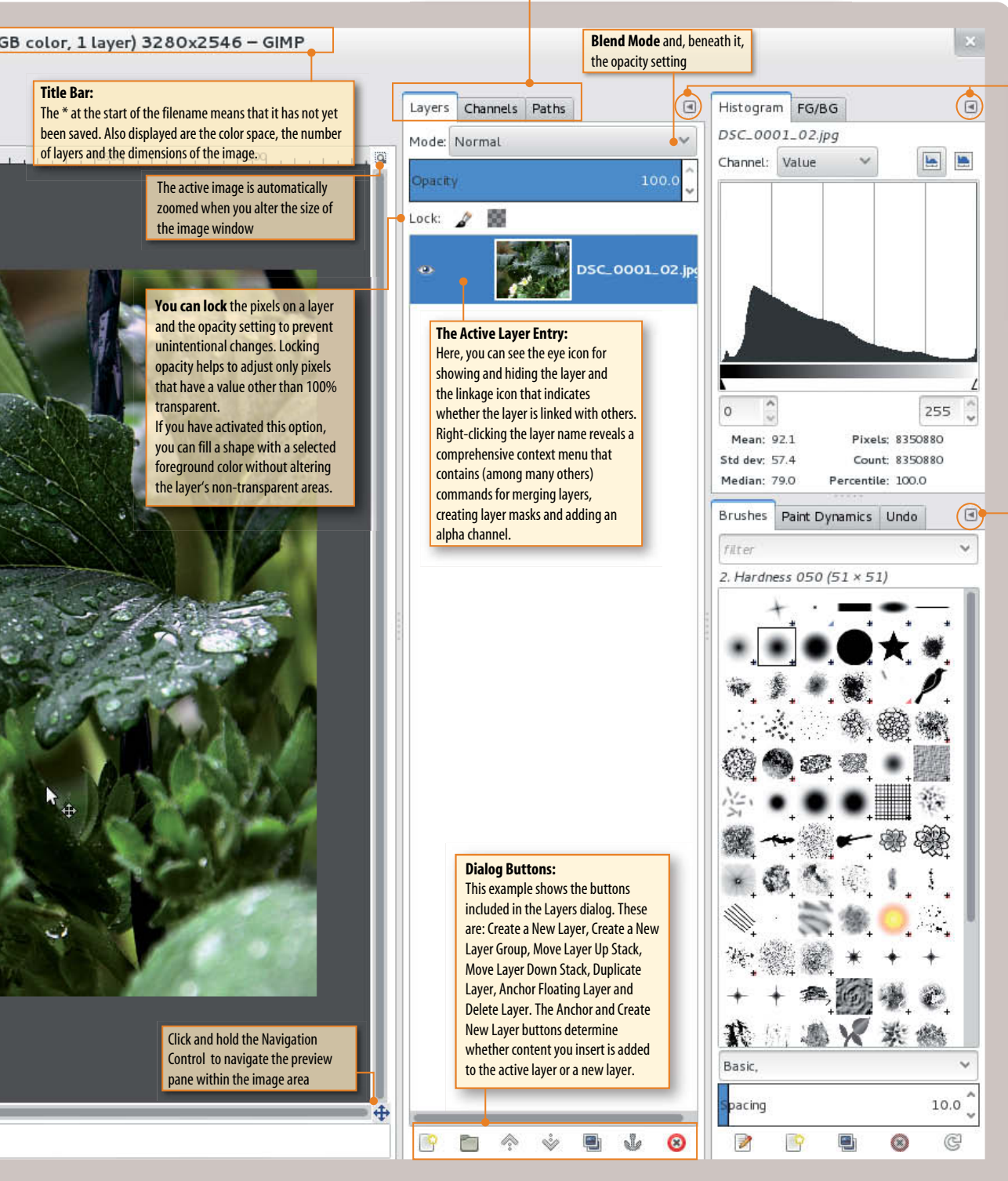
Menu Button:
Click the Menu Button to display the Image Menu in a column (essential in full screen mode). Right-clicking within the image window is another way to open the same menu.

Active Colors:
Click on the foreground or background color to open the Change Color dialog. If selected in the *Preferences* dialog, this panel also shows the current brush, pattern and gradient settings.

Active Image:
Here, the canvas has been configured with dark padding. This setting can be adjusted in *Preferences > Image Windows > Appearance > Canvas padding mode*.

QuickMask Toggle:
Shows the current selection as a translucent screen overlaid on the active image. Right-clicking the icon reveals a context menu with configuration settings for the mask.

Status Bar:
Displays the current pointer coordinates, the Units menu, and the current zoom setting. Pressing the **1** key switches to the 100% view and the **2, 3** and **4** keys each double the previous zoom ratio. Use *Ctrl+scroll wheel* to scroll through the zoom steps incrementally. The amount of system memory used by the current image is also displayed.



This is where **dialogs can be dragged** to a single dock. In this example, the Layers, Channels and Paths dialogs are grouped in one dock, while FG/BG, Histogram, Undo History, Brush and Paint Dynamics are grouped in another.

GB color, 1 layer) 3280x2546 – GIMP

Title Bar:
The * at the start of the filename means that it has not yet been saved. Also displayed are the color space, the number of layers and the dimensions of the image.

The active image is automatically zoomed when you alter the size of the image window

You can lock the pixels on a layer and the opacity setting to prevent unintentional changes. Locking opacity helps to adjust only pixels that have a value other than 100% transparent. If you have activated this option, you can fill a shape with a selected foreground color without altering the layer's non-transparent areas.

The Active Layer Entry:
Here, you can see the eye icon for showing and hiding the layer and the linkage icon that indicates whether the layer is linked with others. Right-clicking the layer name reveals a comprehensive context menu that contains (among many others) commands for merging layers, creating layer masks and adding an alpha channel.

Dialog Buttons:
This example shows the buttons included in the Layers dialog. These are: Create a New Layer, Create a New Layer Group, Move Layer Up Stack, Move Layer Down Stack, Duplicate Layer, Anchor Floating Layer and Delete Layer. The Anchor and Create New Layer buttons determine whether content you insert is added to the active layer or a new layer.

Click and hold the Navigation Control to navigate the preview pane within the image area

Blend Mode and, beneath it, the opacity setting

The Tab Configuration Menu is inconspicuous but very useful. Here, you can alter the tab style to include icons, text or both, and alter the size of the icons to save space. In our example, the icons have been hidden and only the text-based tab names are shown.

Important Processes and Tools

GIMP is an extremely versatile program and has a correspondingly large range of tools and dialogs. The following sections describe some of the most common of these.

We begin by taking a look at the two most important tools for adjusting image contrast, the Curves and Levels dialogs. (The Levels dialog can also be used to adjust white balance.) We also provide some tips on how to crop images effectively and point out

pitfalls to be aware of when saving and exporting edited image files. The save and export functions were radically rejigged in the latest version and have been the subject of some serious controversy within the community.

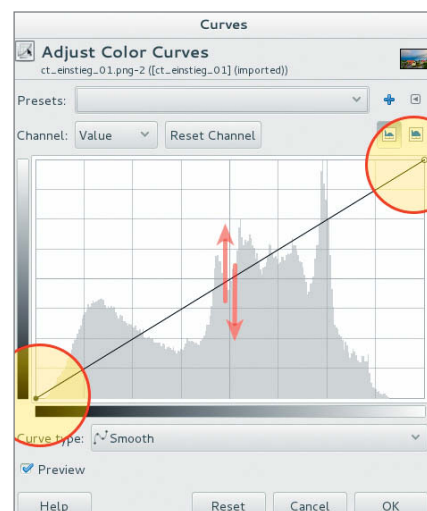
The Curves Dialog

Of all the editing tools offered by *GIMP*, the Curves dialog (Colors > Curves) is probably the most important. Using the manipulable curve superimposed on the histogram, you can precisely adjust the brightness and contrast of an image. Clicking on the curve automatically creates a new 'anchor' that you can then shift up or down to lighten or darken the image.

The dialog provides tools for loading and saving preset curves, adjusting individual color channels and altering the type of curve that is applied. The 'Smooth' curve type smooths the transition between anchors and increases or decreases the brightness of neighboring pixels accordingly, while the 'Freehand' curve type enables you to address specific brightness values individually. You

can toggle your change on and off by checking and unchecking the Preview box, or simply leave it checked to see the effect of your changes in real time. An inactive (black) anchor can be deleted either by pressing the Del key or dragging it out of the histogram frame.

The Curves dialog automatically saves all your recently used curves

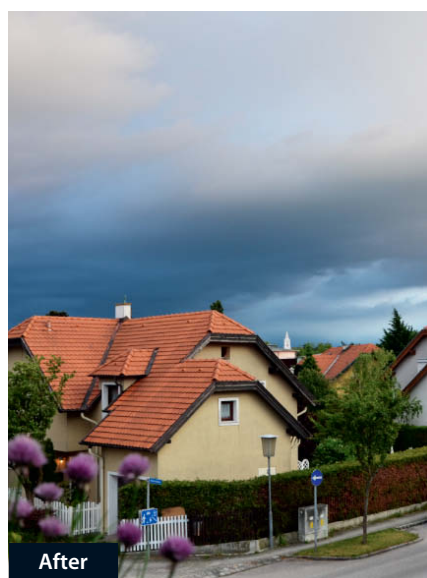
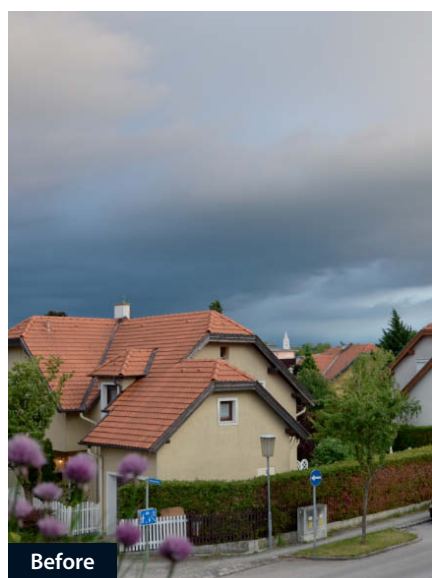


Applying an S-Curve

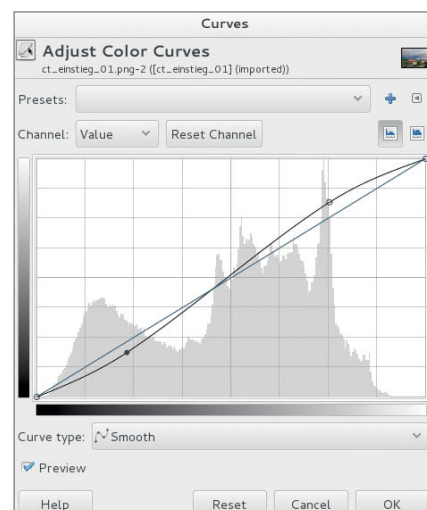
Applying an S-shaped curve is a simple and effective way to simultaneously brighten the highlights and emphasize the shadows in an image. This is achieved by shifting the upper

anchor upward and the lower anchor downward. The result of these two shifts is an increase in overall contrast, which is illustrated very well by the more intense

appearance of the clouds in our example below. An inverted S-curve reduces contrast and makes an image look paler.



The effect of applying an S-curve



Controlling Transparency

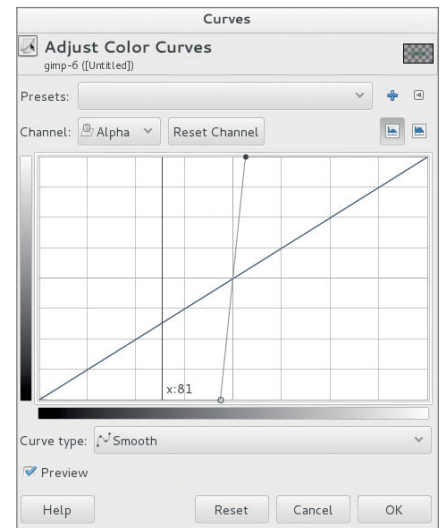
The Alpha channel in the Curves dialog can be used to adjust the transparency of semi-transparent objects. To achieve this effect, we created a text object with reduced opacity, opened the Curves dialog and switched to the Alpha channel (i.e., the channel that contains the transparency setting). We then shifted the upper right-hand and lower left-hand anchor points toward the center of the top and bottom axes. This change makes semi-transparent pixels completely transparent while the darker, partially filled pixels become completely filled and well defined.



Semi-transparent text



100% transparency



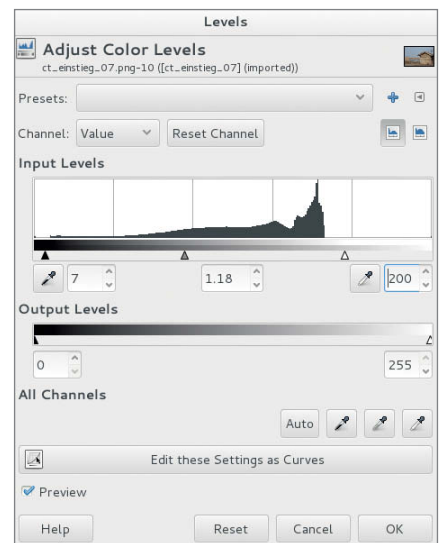
Adjusting White Balance Using the Levels Dialog

The Levels dialog (Colors > Levels) is another tool that is often used to adjust brightness and tonal values. While the Curves dialog is good for adjusting individual tones, the Levels dialog is better suited to adjusting the distribution of brightness values (i.e., tonal levels) within an image. It is most often used to adjust white balance.

The two eyedroppers located beneath the Input Levels graph are extremely important and are used to select the darkest and brightest tonal values in the image. Once you have made these selections, GIMP automatically adjusts the contrast between all the pixels in the image to match. The black, gray and white triangular sliders beneath the histogram are used to determine which tones are clipped – in other words, the point at

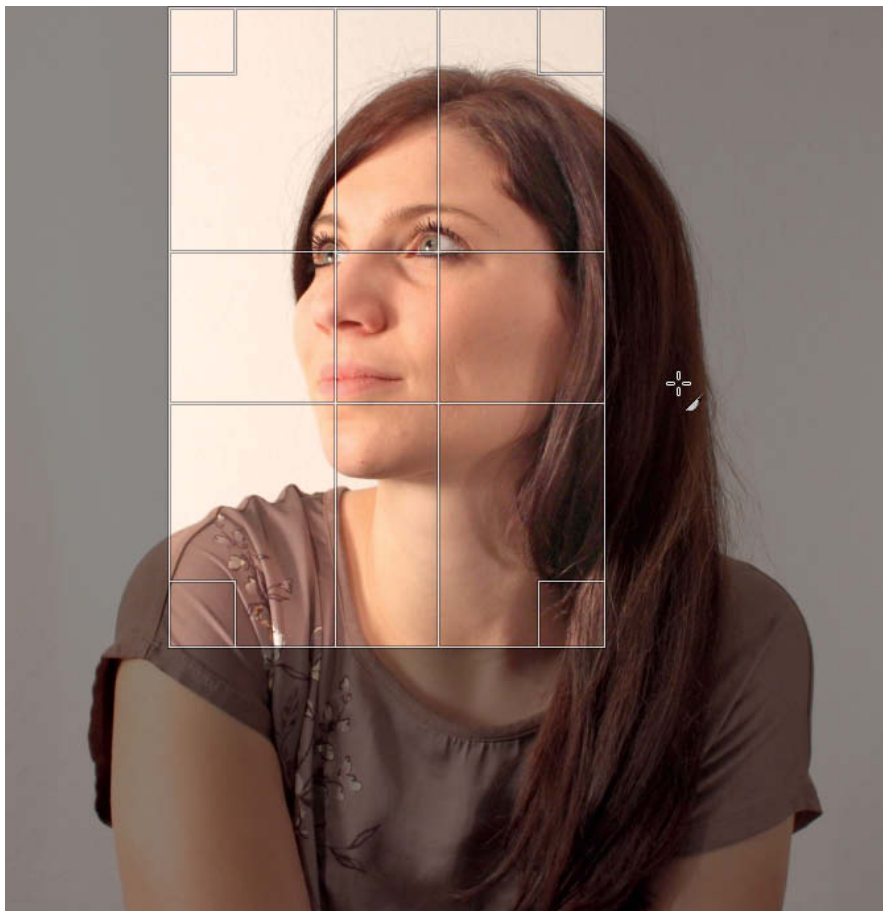
which dark gray tones tend to black and light gray tones tend to white. The center ('gamma') slider determines the level of the mid-gray tones and can thus be used to adjust the overall brightness. The 'Auto' button adjusts white balance automatically and has the same effect as using the Colors > Auto > White Balance command. However, use this button with care, as the results are often imperfect and are better used as a starting point for your own manual adjustments.

The Levels dialog can be used to adjust image brightness and tonal range



Artistic Cropping

If you need to crop an image for whatever reason, basic rules of aesthetics such as the 'rule of thirds', the 'rule of fifths' and the 'golden section' help to produce a final image with a pleasing composition. *GIMP* includes overlay guides for all these rules and more to help you find just the right position for the most important elements of your subject. Simply activate the Crop tool (Shift+C), and select the appropriate guide from the drop-down menu at the foot of the Tool Options panel.



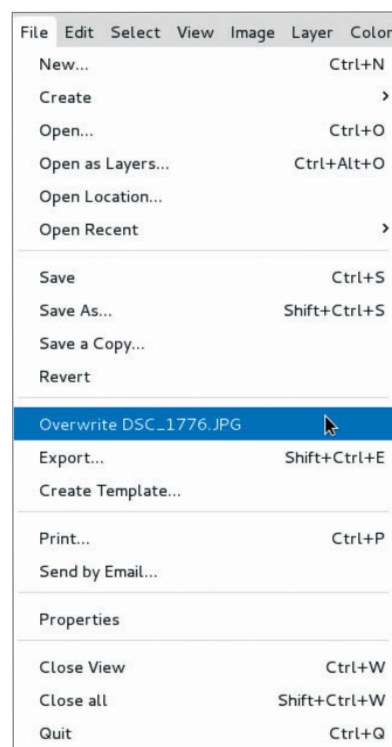
The Crop tool include various overlay guides to assist you in selecting your final composition

Lossless Save and Export

Version 2.8 introduced a completely new approach to saving and exporting files. The File > Save As... command now only saves files to *GIMP*'s native XCF format (or the .xcf.bz2/.xcf.gz compressed formats). This is the only format that guarantees to preserve all the channel, layer and path data included in an image, and is thus the best option when saving heavily edited images. Using the File > Export command saves a copy of the current file to a selected conventional format such as JPG, TIFF, PNG or one of a range of other options. *GIMP* currently only supports 8 bpc (bits per color channel) files, but the upcoming version 2.10 will support 16-bit file formats too. The File menu also includes the new Overwrite command, which is useful if all you want to do is open a file, make a quick adjustment and save it. This command requires you to confirm the changes you have made before overwriting.

If you need to use the Overwrite command regularly, why not set up a custom accelerator (hotkey) using the Edit > Keyboard Shortcuts dialog? This will speed up your daily workflow significantly.

The proprietary XCF format is the best option for saving heavily edited image files. If you are absolutely certain that you no longer need the original, you can use the Overwrite command in the File menu.



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Three Ways to Remove a Color Cast

The portrait shown below left has a warm color cast that makes the photo look incorrectly exposed. The following pages detail three different ways to effectively remove this cast.

Mixed light sources, the wrong white balance setting or some other unforeseen factor can cause an incorrect exposure, and *GIMP* offers various ways to tackle this type of problem.



Method #1: Using Color Balance

The simplest and most obvious method is to use the **Color Balance dialog** (Colors > Color Balance – see the illustration in Step 2). In this case, the shadow, midtone and highlight tones are altered in relation to the tonal values in the active layer.

Step 1 The best way to get a feel for the colors in an image and how to adjust them is to use the color wheel tool (Windows > Dockable Dialogs > Colors). The color to look out for is the one opposite the one you want to adjust (i.e., its complementary color). In this case, we want to reduce the yellow tone, so we need to adjust the cyan and blue tones accordingly.

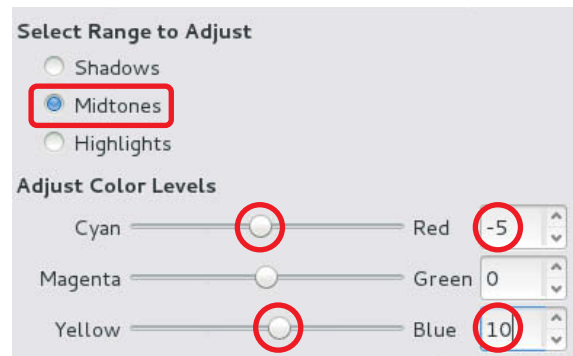
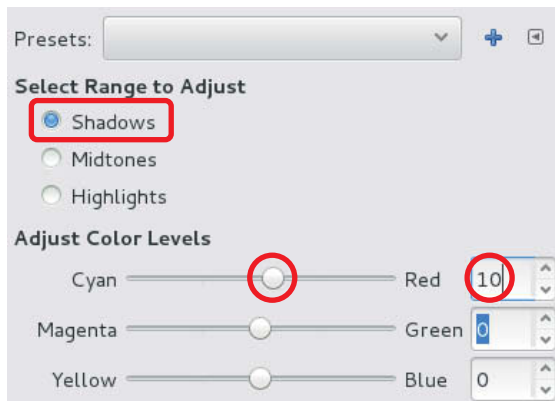
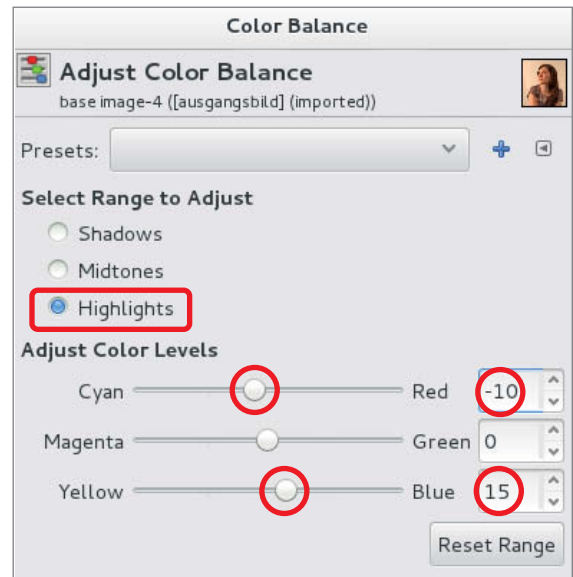


It is important to identify the complementary of the color you wish to adjust

Step 2

Because *GIMP* doesn't yet support adjustment layers, it is best to perform color corrections on a duplicate image layer. We already identified the colors that require tweaking in step 1, so open the Color Balance dialog (Colors > Color Balance) to proceed. Begin by selecting the range that requires the most adjustment (in this case, the highlights) and intensify your chosen tone by shifting the appropriate slider toward the name of the corresponding color. We selected values of +15 Yellow/Blue and -10 Cyan/Red and left Magenta/Green as it was. The midtones in our original image were also a little too yellow, so we adjusted these too, using less severe values of -5/0/10.

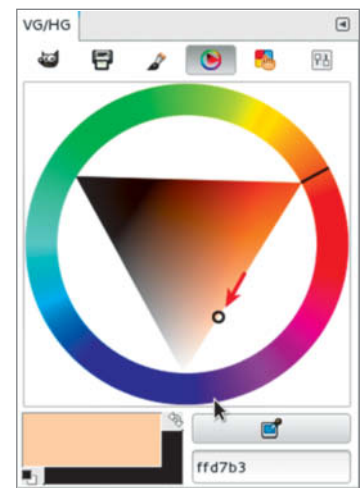
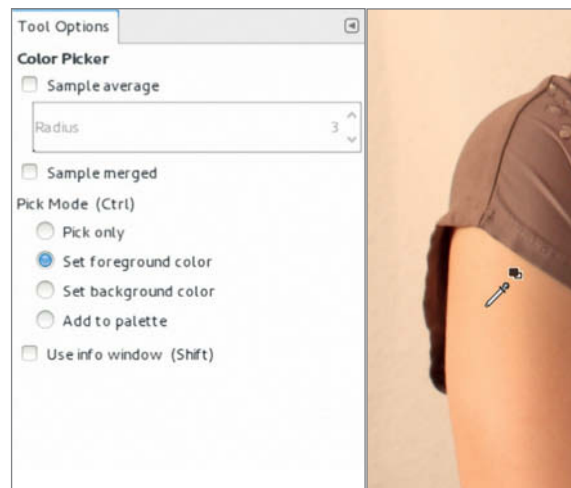
These types of adjustments can reduce color intensity in the shadows (in the darker parts of our subject's hair, for example), and shifting the Cyan/Red slider toward the red end of the scale can help to alleviate any imbalance. We used values of 10/0/0.

**Method #2: Using Blend Modes**

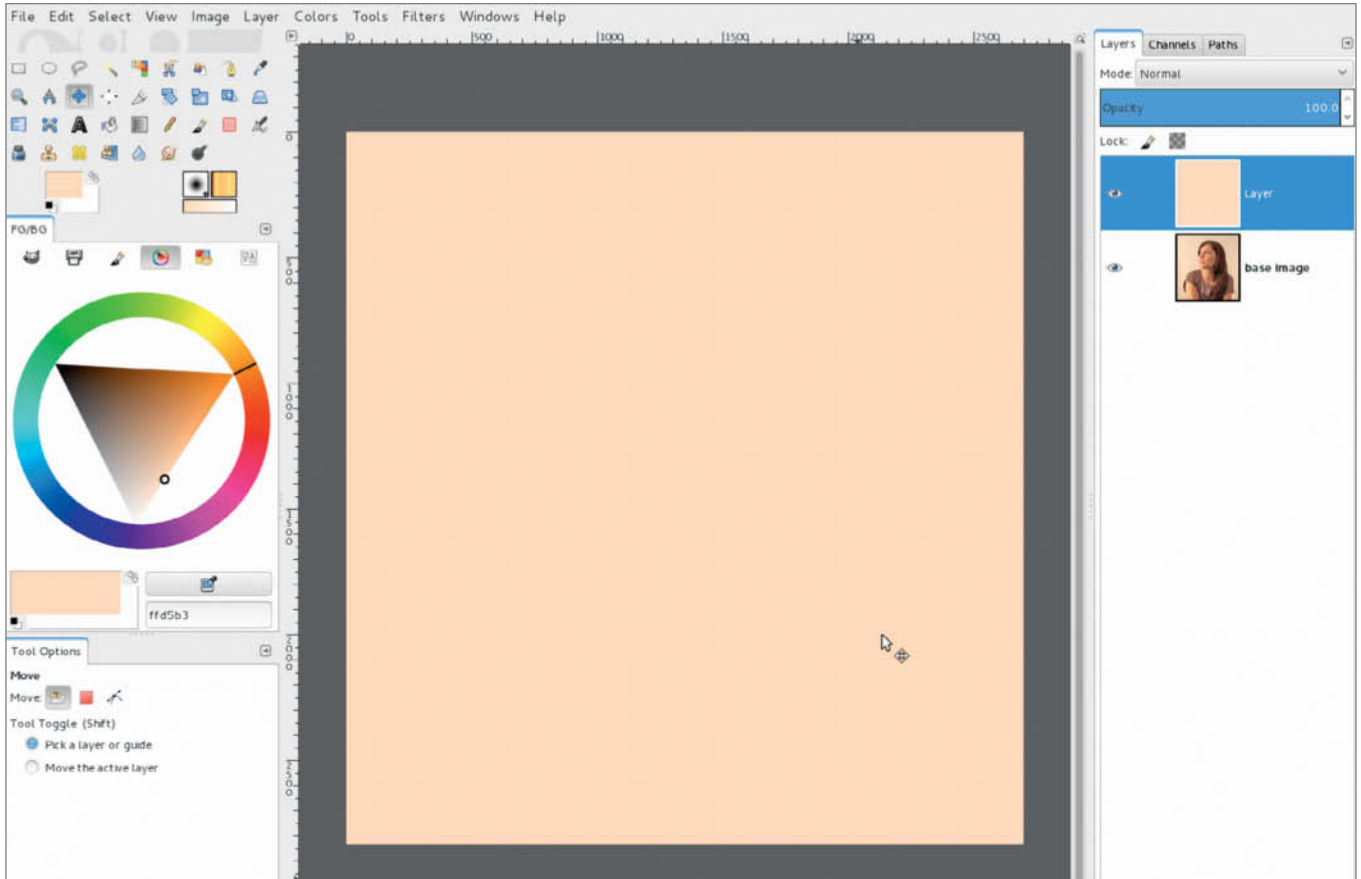
An intuitive way to remove color casts is to use a new layer to 'tell' the original image which color is incorrectly depicted (i.e., the tone or tones that are too yellow in the original).

Step 1

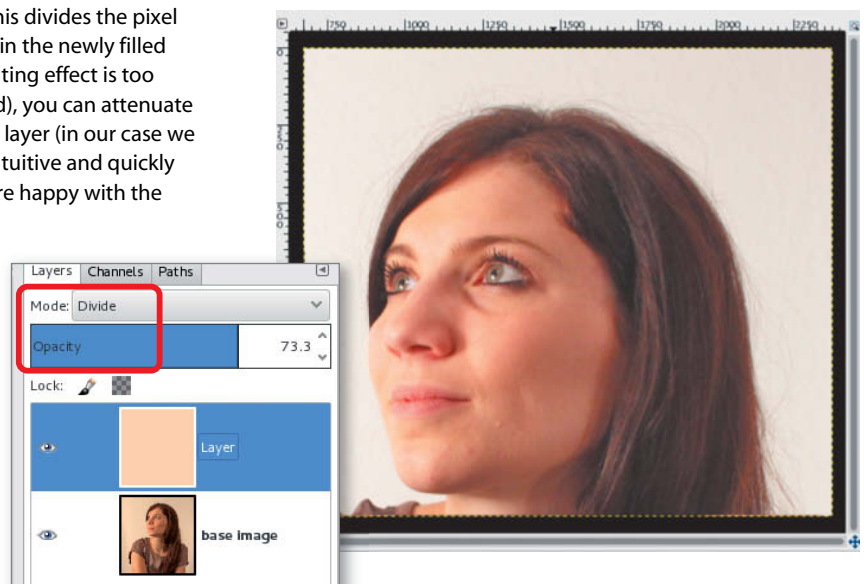
Begin by creating a new layer above the image layer. Now select the eyedropper and use it to select an area that shows the color cast you wish to remove (we selected our subject's upper arm). In order to retain the base color in the selected image element, brighten it slightly – for example, by shifting the cursor along the appropriate axis within the color wheel.



Step 2 Fill the new layer with the color you have just selected (Edit > Fill with FG Color)



Step 3 Set the new layer's mode to Divide. This divides the pixel values on the lower layer by the ones in the newly filled layer, thus removing them. If the resulting effect is too strong (i.e., too much color is removed), you can attenuate it by reducing the opacity of the color layer (in our case we set it to 70%). This method is highly intuitive and quickly leads to satisfying results. Once you are happy with the effect you have produced, selecting the Layer > New from Visible command merges the background (image) layer with the subtracted color layer and creates a new combined layer which you can then edit further.

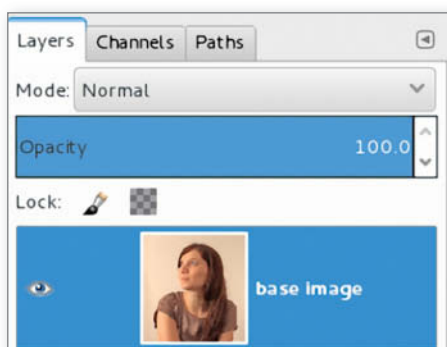


Method #3: Using Color Temperature

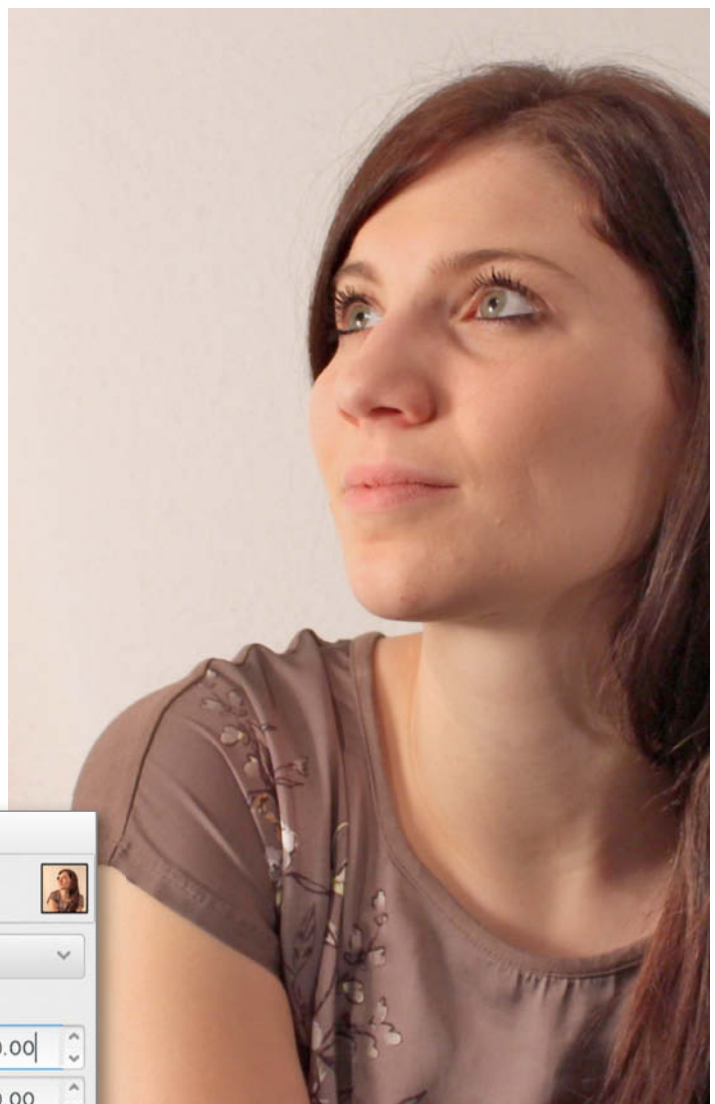
The quickest way to remove a color cast is by way of the color temperature sliders, which are part of an experimental GEGL filter in the current version of the program. This works very well indeed and is slated to be fully integrated in the upcoming 2.10 version.

To perform a color temperature correction, navigate to Tools > GEGL Operation and select the *color-temperature*

option in the drop-down menu at the top of the dialog that opens. You can alter your image by entering Kelvin-based values to either increase the original color temperature or reduce the “intended temperature”. In our case, a difference of 800 K between the two values produced the result we were aiming for.



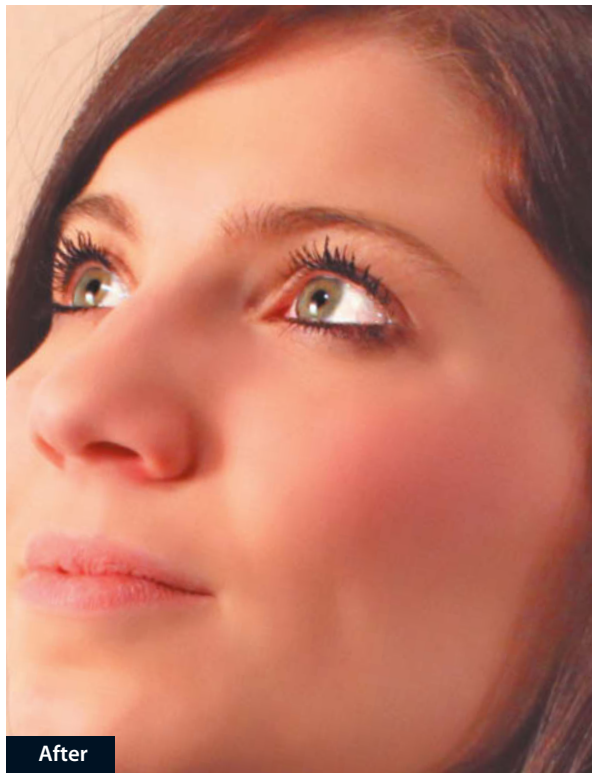
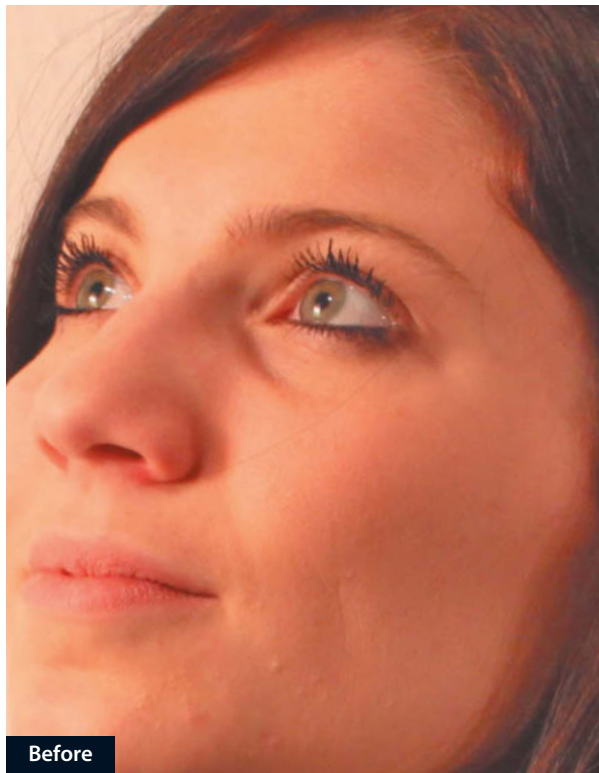
Always perform significant adjustments on a duplicate of the original image



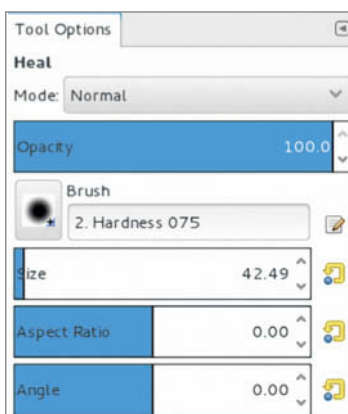
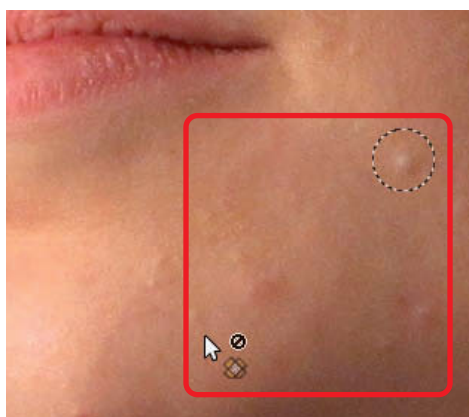
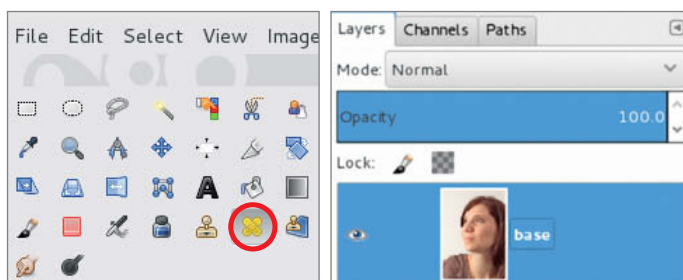
Retouching Portraits

Now we have removed the underlying color cast we can concentrate on improving our new, 'clear' portrait image. The

following sections explain how to produce even-looking skin tones, apply 'digital make-up' and add shine to the subject's eyes.

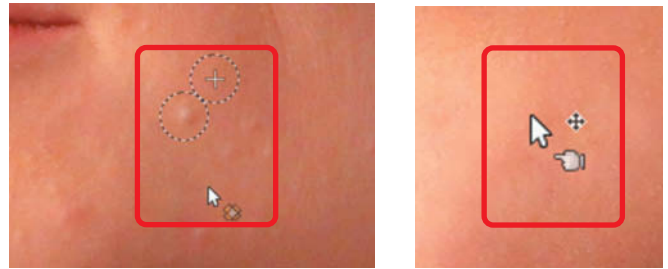


Step 1 The first step involves using the Healing tool to remove skin blemishes. Unlike the Clone tool, this tool is capable of detecting the brightness of the surrounding pixels and adapts the cloned elements to match the brightness of the target area (i.e., the place where you insert the copied pixels). Use a soft brush tip with a size setting of about 45 for this type of work.



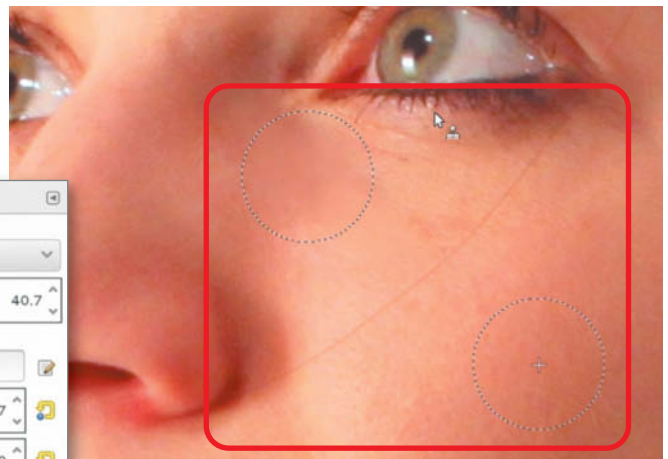
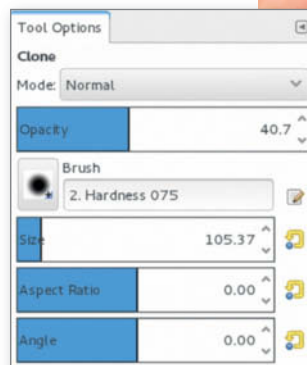
Step 2

Select source pixels with the Ctrl key pressed, then release the Ctrl key and click on the area where you want to insert the source material. The circle with the 'plus' sign in it shows the location of the source pixels. Repeat this process as often as necessary for all minor blemishes.

**Step 3**

We used the Clone tool to cover the dark circles beneath our subject's eyes. For tasks like this, it is best to set opacity to 30-50% and cover any blemishes successively. If you use too high an opacity value you run the risk of overdoing the effect. We will address the slight blur that this step produces in the steps below.

Reduce skin blemishes slowly and carefully but never completely. A face with a few wrinkles looks much more natural than a portrait in which all the wrinkles have been 'ironed out'.

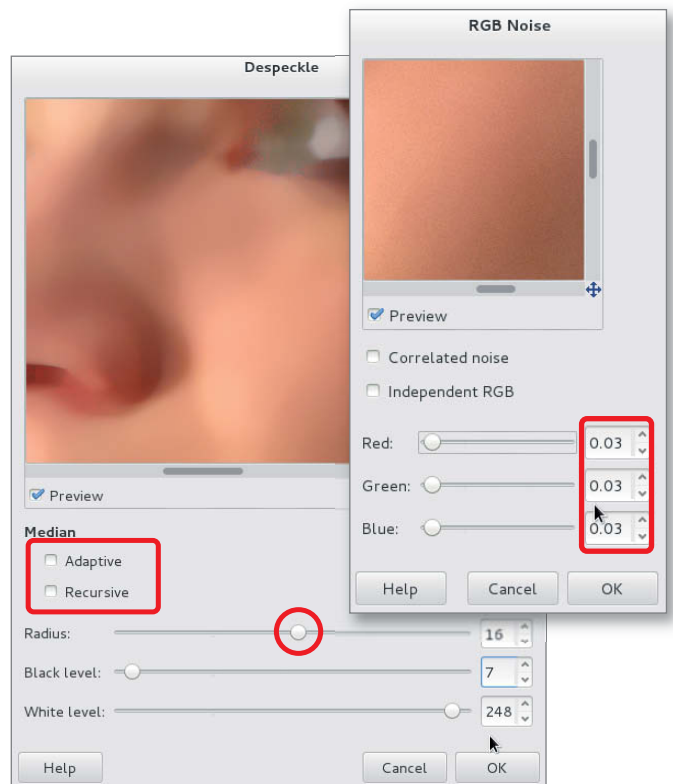


Here, we used the Clone tool with a brush size of about 100px and 40% opacity

Step 4

We added an additional soft-focus effect to give our portrait a smooth overall look. Conventional blur effects such as Gaussian Blur are not suitable for portrait work, as they blur the entire image to the same degree. Instead, we used the Filter > Enhance > Despeckle tool. We unchecked the *Adaptive* and *Recursive* options and set the Radius to 16. Applying this filter doesn't affect the base tonal values or contrast.

Another great trick for making skin look natural is to add simulated 'pores' using a mild application of the RGB Noise filter (Filter > Noise > RGB Noise). We unchecked the *Correlated noise* option and used a value of 0.30 for all three RGB channels. This step can be repeated until the desired effect is achieved.



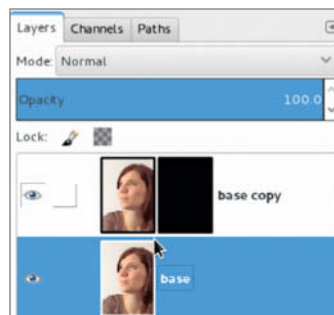
Step 5

We then applied the Blur filter (Filter > Blur > Blur) to take some of the sharpness off the pixels created by adding noise. As an option, you can also accentuate the pores using the Filter > Enhance > Sharpen tool. The amount of sharpness you need to add will vary from image to image.



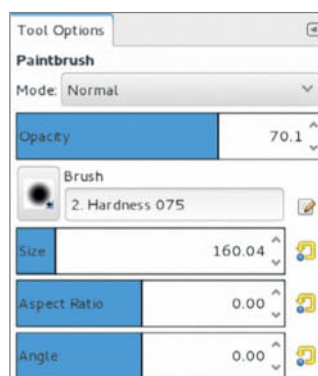
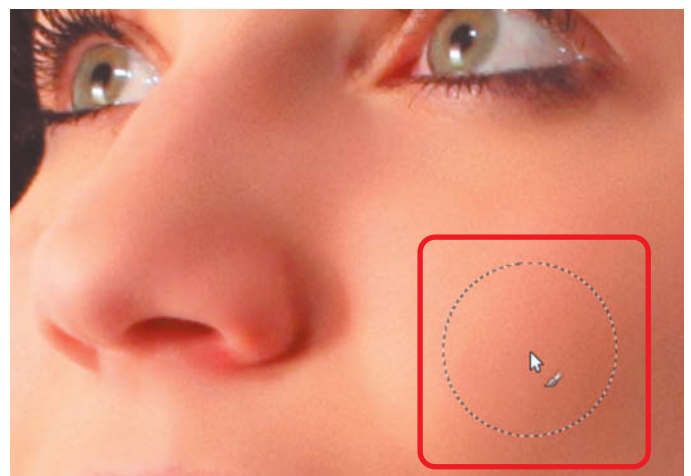
Step 6

The simplest way to apply your newly generated skin tone to the original image is to hide all but the areas you wish to alter and apply the remainder. Because your edited skin tones are saved on a separate layer, you can do this by creating a layer mask. The quickest way to do this is using the Add Layer Mask command in the layer's context menu. In the dialog that results, select the *Black (full transparency)* option.



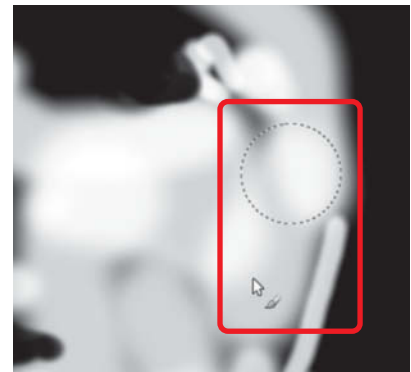
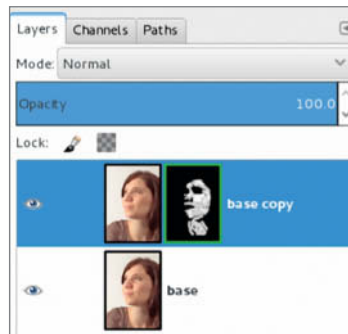
Step 7

Now select a soft brush with a size setting of about 150px and 70% opacity. Leave the foreground/background colors at their standard settings and press the D key to switch the foreground color to black. Now all you have to do is use the brush to paint the new skin structure into the original image (in our case, mainly in the subject's cheeks). Pressing the X key toggles the foreground and background colors, enabling you to correct mistakes immediately if you apply too many brush strokes to a particular area of the mask.



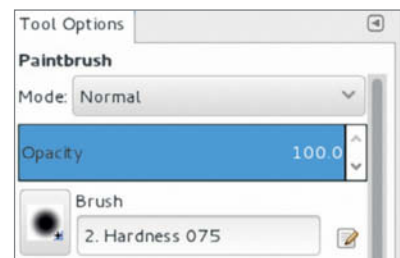
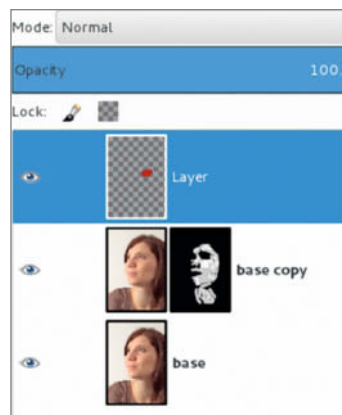
Step 8

If you click on the layer mask with the Alt key pressed, *GIMP* automatically superimposes the mask on the image and displays a magnified view. This is a great aid when it comes to making precision adjustments to a mask.

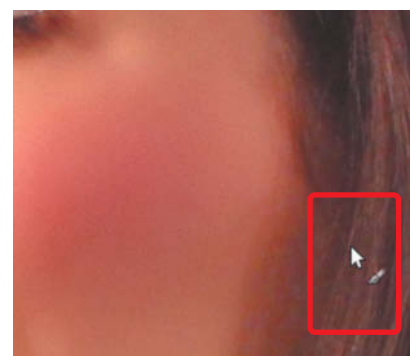
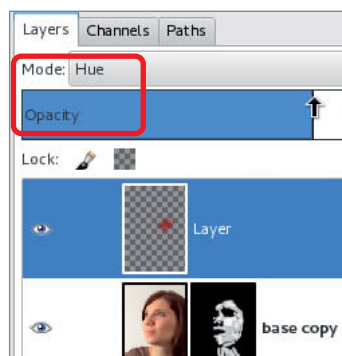
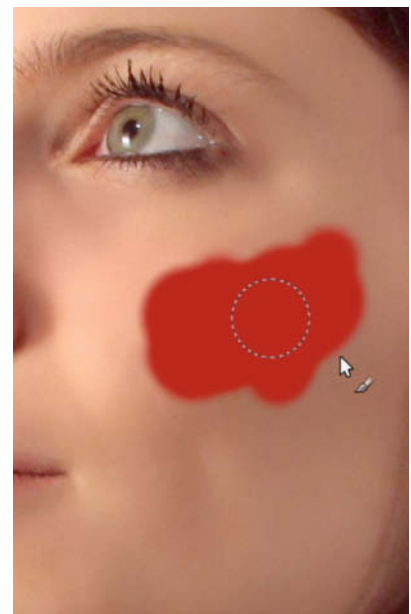
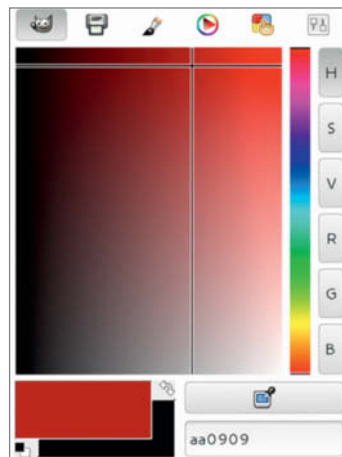


Step 9

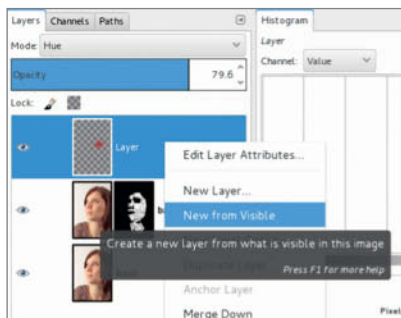
To add a little blusher, create a new transparent layer and use the Brush tool and a deep red color to add a few dabs to the cheeks. We used code aa0909, which equates to RGB values of 170/9/9. You can then use the Filter > Blur > Gaussian Blur tool with a Radius value of about 200 to fine-tune the effect.



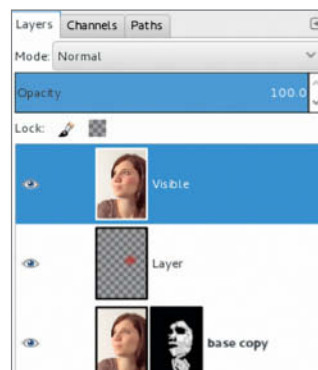
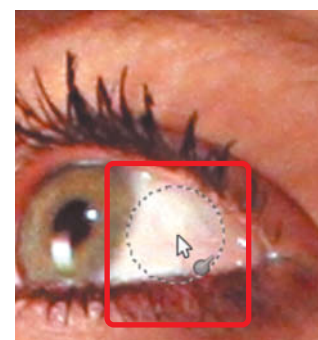
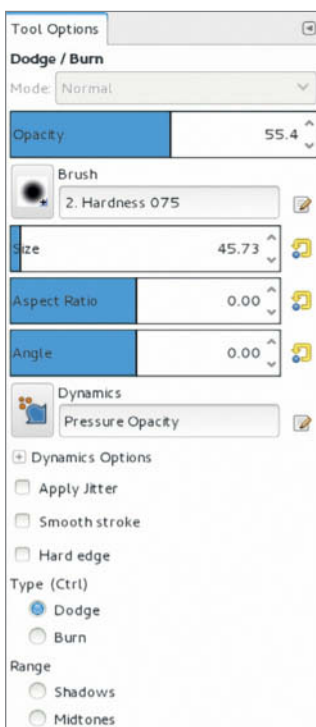
Setting the blend mode to Hue produced the best results for our example, but you can experiment with other modes, such as Overlay, Soft Light or Merge Grain, to vary the effect. Try different opacity settings too.



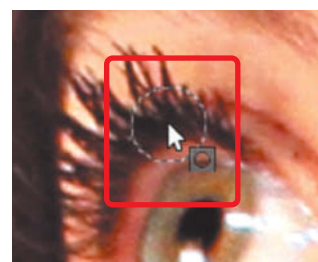
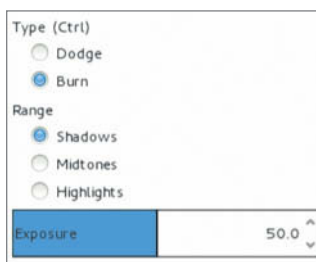
Step 10 We then increased contrast around the subject's eyes. To do this, we created a new layer (Layer > New from Visible) and sharpened the whole layer using the Filter > Enhance > Unsharp Mask tool with its default settings of 5/0.50/0.



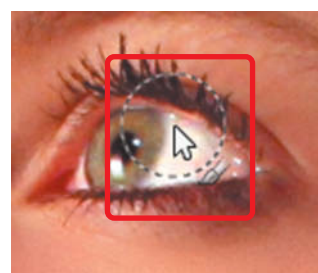
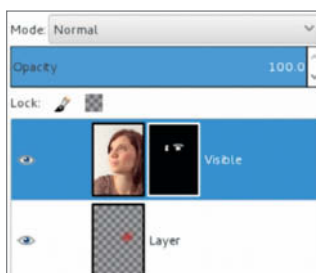
Step 11 To brighten the whites of the eyes, we selected the Dodge/Burn tool with a small, soft brush tip that was slightly larger than the pupil. We set the tool type to Dodge and the Range setting to *Highlights* and used it to brighten the reflections in the pupil and iris too.



Step 12 We darkened the pupil using the Dodge/Burn tool in Burn mode in the *Shadows* range. Eyelashes can benefit from this treatment too.

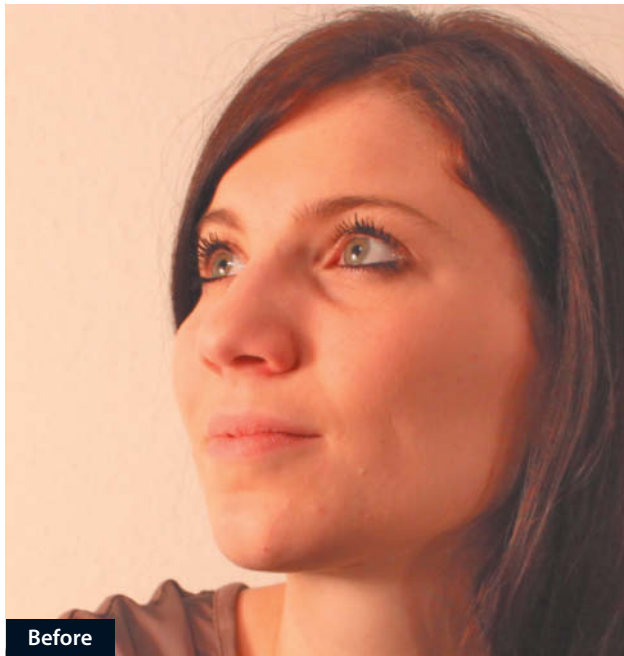


Step 13 Finally, we used a black layer mask (see step 6 above) and a white brush to paint the adjustments we had just made into the original image.

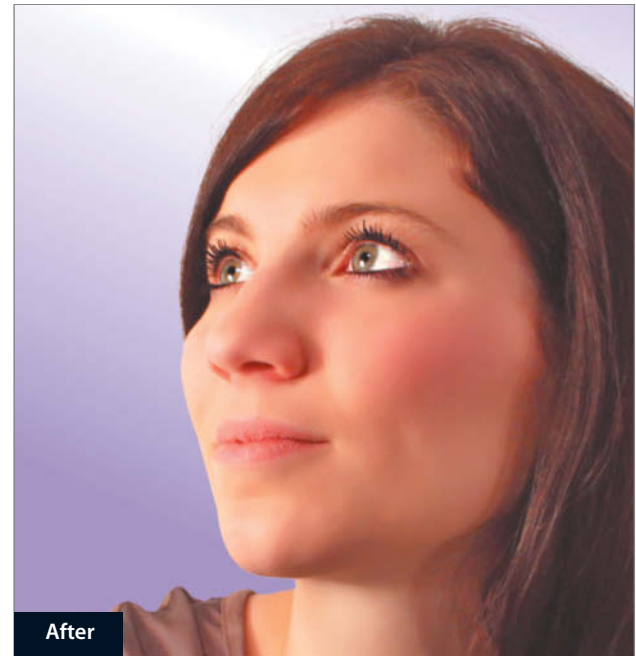


Selecting Fine Details

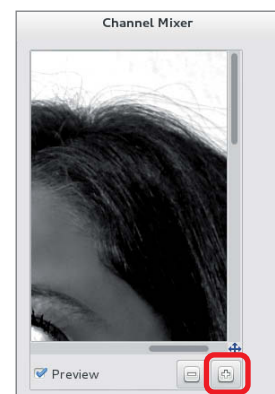
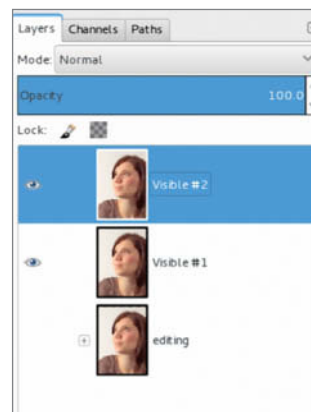
If you want to add a new, more interesting background to a portrait, fine details such as stray hairs can make it quite tricky to make a clean selection. The steps outlined on the following pages



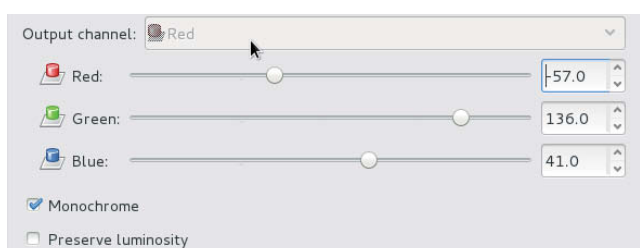
show you how to create a mask that follows even the finest lines in the original photo precisely.



Step 1 If you have just finished an editing process like the one described on the preceding pages, the first thing to do is merge the various layers you have created into one using the Layer > New from Visible command. The editing steps we already performed have been gathered in a layer group, shown here in its collapsed state. Now duplicate the new layer and activate the duplicate.



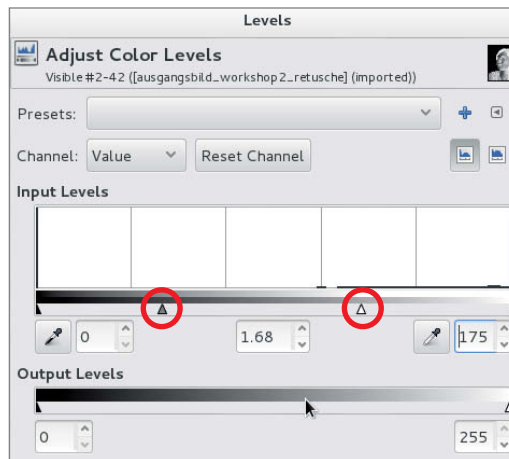
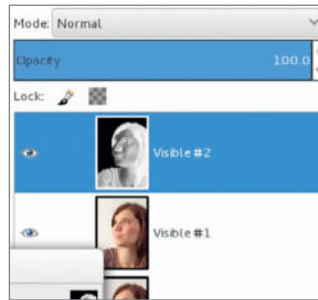
Step 2 The next step involves creating a black-and-white copy of the original image layer with the aim of using the Colors > Components > Channel Mixer command to increase the contrast between the subject's hair and the background. Zoom in using the + magnifier to get a better view and then adjust the red, green and blue sliders until the background is as near white as possible while retaining a clear view of the detail you wish to preserve. For details as fine as human hair, it often helps to adjust the green channel, which often contains the greatest contrasts. The red and blue channels usually contain mostly bright details.



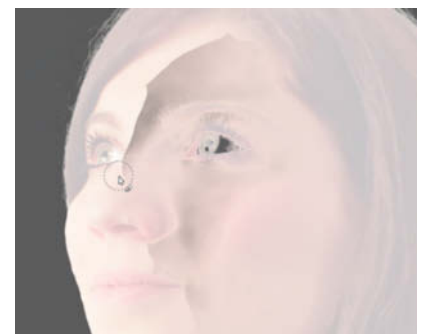
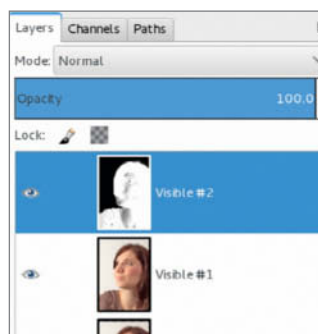
Step 3

Now invert the channel mixed layer using the Colors > Invert command and edit out any remaining skin blemishes using a black brush. You can now use the Colors > Levels dialog to adjust the tonal range. Shifting the triangular white (highlights) slider to the left converts light grays to white, and shifting the black (shadows) slider to the right converts dark grays to black. The gray (gamma) slider in the center determines the level at which neutral gray is set. To preserve detail in the hair in our example, we shifted the gamma slider to the left so as to retain more of the light gray tones in our subject's hair.

To enlarge or reduce the size of the brush tip on the fly, press AltGr+8 or 9. Remember, too, that you can toggle between the current foreground and background colors using the X key.

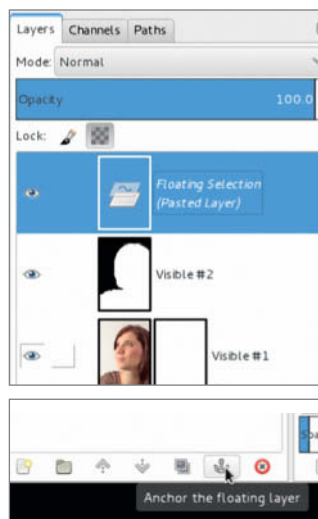
**Step 4**

We have already mastered the most difficult details, so it is now time to take a white brush and precisely trace the outlines of our subject's face and blouse. The easiest way to do this is to reduce the opacity of the black-and-white layer so that the 'real' edges show through. When outlining details like these, it is important to periodically switch to a 100% opacity view so that you can still see the remaining gray tones. The finished mask should look something like the one shown on the right, consisting mainly of pure black and pure white areas and some gray tones where individual hairs are visible (see step 5 below).

**Step 5**

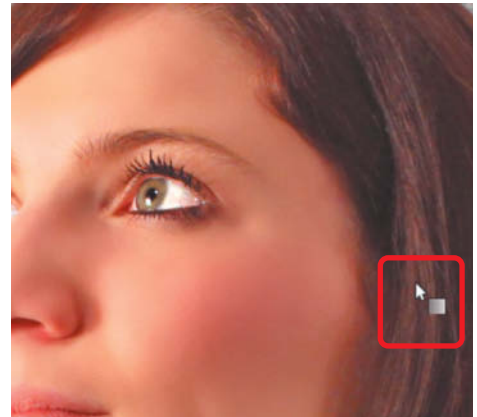
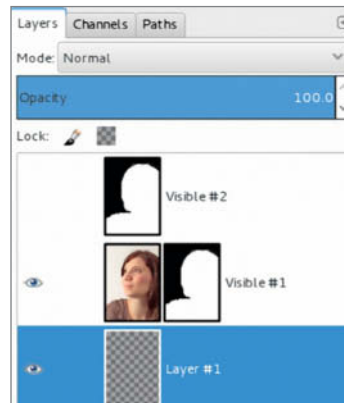
Now select the entire mask layer (Ctrl+A), copy it (Ctrl+C) and activate the layer beneath. Create a new layer mask and use Ctrl+V to insert the copied mask.

The inserted content is initially floating (i.e., can still be moved and edited), so you need to anchor it to the new layer mask by clicking the 'Anchor floating layer' button at the bottom of the Layers dialog.

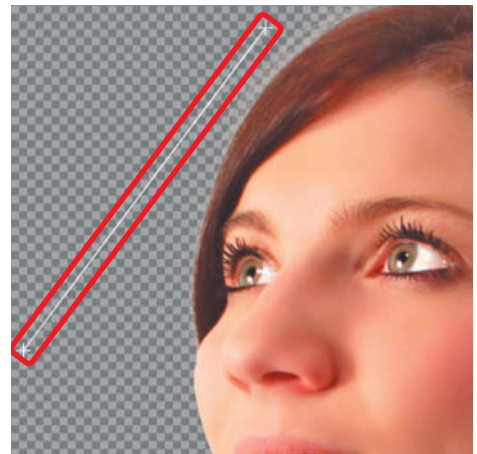
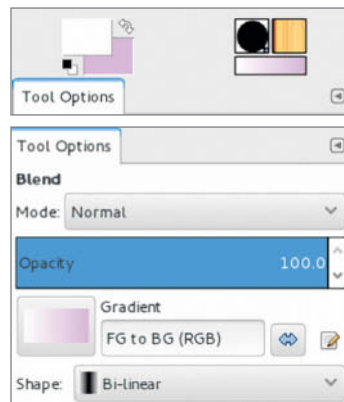


Step 6

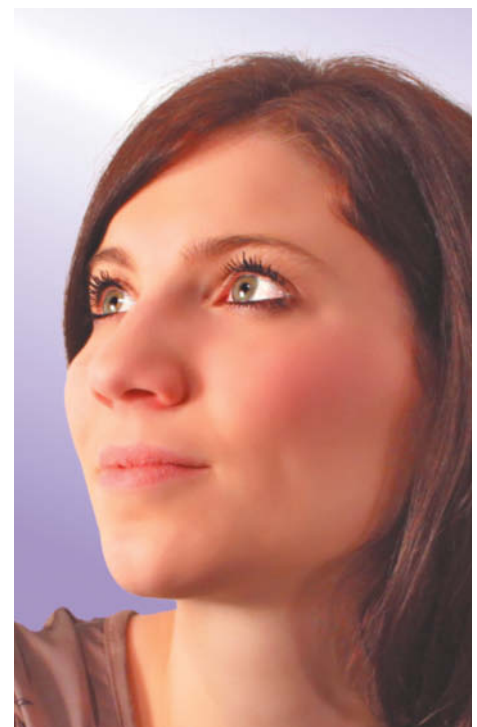
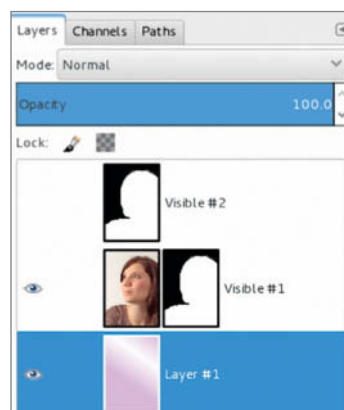
Click the eye icon to hide the black-and-white layer, then create a new transparent layer beneath the image layer and select the Blend tool

**Step 7**

Set the foreground color to white and the background color to whatever color you like. Set the Shape option to *Bi-linear* in the Tool Options and drag a gradient diagonally down to the left, starting at the subject's forehead.

**Step 8**

Our image is finished. One final tip: if you are using a dark background color, switch to the layer mask and shift the midtone (gamma) slider in the Levels dialog slightly to the right. This ensures that any details in the hair that are too bright disappear and that no gray background shows through where the individual hairs have been selected.







Ralph Altmann

The Future of Digital Imaging

Bigger, better, sharper! While the major trends in photography over the last few years have given rise to a lot of exciting technical innovations, very little has changed in the way we actually capture photos. However, research institutes and camera manufacturers don't just hone existing technology – they are also working on completely new approaches to digital imaging that promise to give the photographers of the future imaging possibilities that the rest of us can barely imagine. Conventional image optimization and error correction processes are already becoming part of in-camera firmware, giving us the freedom to concentrate on getting really creative.



A young man has been asked to take photos at a family wedding using his brand new camera, but no-one is paying any attention to his requests to pose or get into groups. Then the weather turns and he has to simply shoot as many photos of all the guests as quickly as he can before the rain starts. Later on, he manages to get a group shot of the bride and groom and all 60 guests from behind the altar. He is much too close to the subject, but his camera's software enables him to capture a sweep panorama and merge the individual source images as he likes later on. Then comes the big moment – the kiss, spoiled only by the massed clicks of everyone else's smartphone cameras and the quiet 'beep' that tells us our hero's memory card is full.

Photo Technology

To predict the future, we must first look at the past. The photos we shoot today are not very different from those captured 170 years ago, but technology has come a long way since the pioneering days, and recent changes have made it much easier for just about anyone to capture sharp, shake-free and well exposed images without a great deal of equipment.

For more than a century, photo engineers made incremental progress as they concentrated on improving the established physical and chemical techniques involved in image capture, development and enlargement. Then digital sensors revolutionized the photographic workflow. Suddenly, an image was 'finished' a fraction of a second after it was captured. An entire industry was rendered obsolete and renowned companies such as Kodak and Polaroid went bankrupt.

However, the basic principles of image capture have not changed since Louis Daguerre made his first historic daguerrotypes. A lens (often larger and heavier than the camera itself) forms a miniature image of the subject on a light-sensitive surface where it is transformed into a virtual image. The fundamental shooting parameters of aperture, exposure time, focal length and focus setting are just as important now as they were in the very first camera, even though the transformation is achieved by microelectronics instead of chemicals.

Today's image creation options are not all that different to those of our forebears either. It's true that we can generally shoot handheld, whereas earlier photographers had to use a tripod and today's zooms replace the multiple lenses of old, but there's still not much we can do to alter the actual content of an image once the shutter has been released.

Subsequent changes to brightness quickly exhaust the camera's dynamic range, the focus setting used at the moment of capture is 'set in stone' and the resulting depth of field is just as immutable. Focal length can only be altered a little (using crop or 'digital zoom' techniques) before the loss of image quality outstrips the potential improvements. We cannot increase the angle of view and the subject will look forever as it did at the moment of capture. If the bridegroom blinked or looked away at

the crucial moment, then that's what we get to see.

A combination of experience, planning and covering all the bases by taking multiple shots of each scene used to be the only way to avoid such pitfalls. 'Light painters' (as photographers often see themselves) could only dream of the freedom enjoyed by 'real' painters. Now, following a decade of

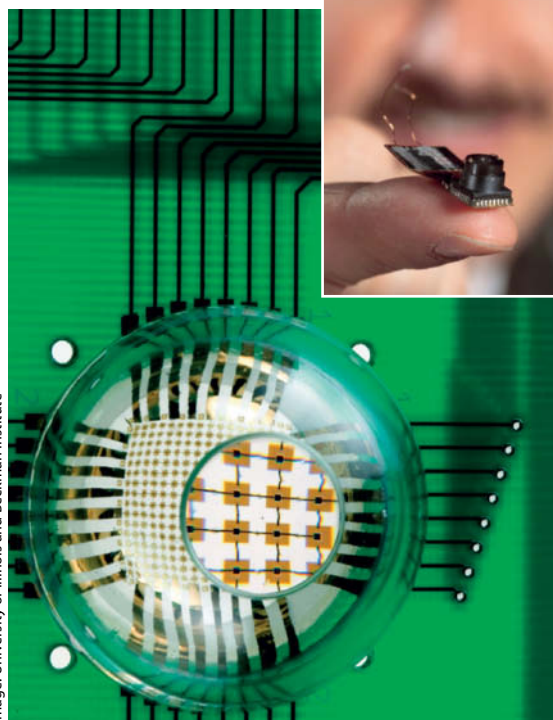


Image: University of Illinois and Beckman Institute

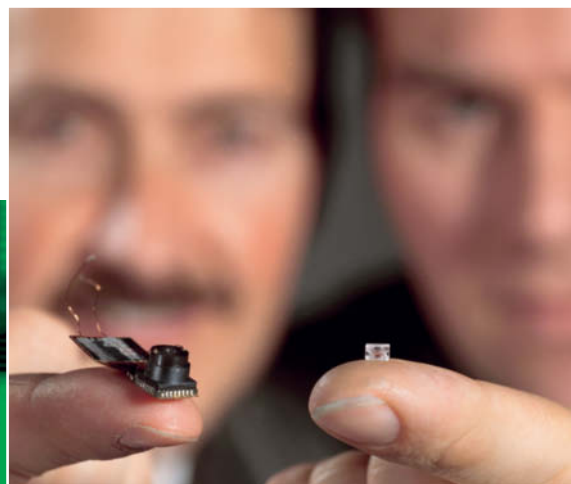


Image: Philips

Inventions such as liquid drop image sensors (on the left) and lenses made of fluids that change their refractive index when an electrical current is applied (like the Philips camera unit including such a lens is pictured above), have the potential to make camera technology a lot simpler and cheaper

discussion about the legitimacy of digital image manipulation, this situation is now beginning to change. 'Smart' software has simplified and automated image processing techniques that used to be the exclusive preserve of pro photographers and have made them available to the mass market. Research institutes and companies, too, are hard at work on innovations that are sure to change not only photographic techniques, but also the very idea of what photography is, possibly to an even greater degree than the digital revolution has already.

Paradigm Change

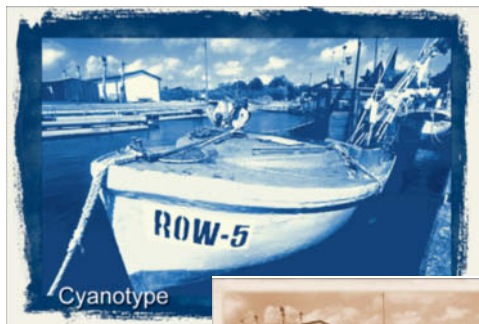
The term 'image processing' can be interpreted in two main ways. It may be used to describe the correction of technical or aesthetic errors such as bad framing, blur, a slanted horizon or color casts or the ability to chemically or electronically reinterpret the imperfections of nature. One of my key photographic experiences was adding dramatic clouds to a photo of my elementary school building using a sponge and a deliberate overdose of developer fluid. Back then, this kind of adjustment was the limit of what an amateur could do to alter the look of a photo.

This aspect of photography has changed dramatically, in that changes that would have taken a whole team of experts days to realize just a few years ago can now be applied with the click of a mouse. 'Creative' tools such as Photoshop's Clone Stamp, Quick Selection, Smudge and Blur, and other tools based on the PatchMatch algorithm (Content-Aware Move, Spot Healing Brush etc.) are redefining the border between photography and painting.

Many conventional image processing tasks are now performed automatically in the camera or invisibly in the background during RAW conversion. Automatic white balance, sharpening, brightness correction, contrast adjustment, color balance, black-and-white conversion and even cropping are all standard features in many of today's cameras. Useful features such as red-eye correction and face and blink detection that started life as consumer-level gimmicks are rapidly finding their way into high-end image capture devices too. Under normal lighting conditions, it is now virtually impossible to shoot technically substandard photos, although



Maybe the analog world was better after all! 'Retro' developing styles that can be applied at the click of a button are a standard feature of just about all contemporary imaging processing software, from Paint Shop Pro (above) to Hipstamatic.



seriously high-key and low-key situations still cause many camera problems. Complementing this technical near perfection, modern camera gear offers photographers countless ways to make their results more aesthetically pleasing, including artificial horizons, built-in ND filters and composition grids.

The more automatic image processing is built into the camera, the less relevant it becomes at the post-processing stage, so, unless you are intent on squeezing the very

last drop of quality out of an image, you can often do without post-processing altogether. Most cameras have a print interface built in and many cameras and smartphones are equipped with wireless upload functionality for Twitter, Facebook and other social media.

However, the digital revolution has also made some things more complicated. In earlier times, if our images showed significant distortion or chromatic aberration, we would have gone out and bought a new lens. Nowadays, such errors can be removed electronically, but only using dedicated software and proprietary lens profiles that usually cost money. Very few cameras have built-in functionality for combating these types of errors, and even where it does exist, it usually only works with same-brand lenses. Color management is a fine invention that helps us to display and output consistent colors on a huge range of device, replacing the analog technique of combining particular film and paper types to ensure color consistency. But why is it still being implemented so inconsistently, 20 years after its introduction?

The ability to use software to compensate for hardware errors has led to the production of increasingly cheap hardware, and many in-camera processes exist only because the hardware surrounding them doesn't do its job properly.



Our hero uses the source images he has captured to create a group portrait on his tablet computer using the source images he has captured. The object detection functionality built into the software has already selected individuals and separated them from the background, so he only has to move them to the right place with a fingertip gesture. Some of the original images were shot in the sun, so he uses an app that calculates the real brightness and reflectivity of the objects contained in the 32-bit images to unify the lighting. He uses the universal standard Lab color space that replaced the sRGB space a number of years ago. As a joke, he transplants the entire wedding party to a tropical island. All he has to do is use his sketch app to draw a couple of palm trees and an elephant or two – the software then searches for appropriate images on the Web and inserts them into the finished image.

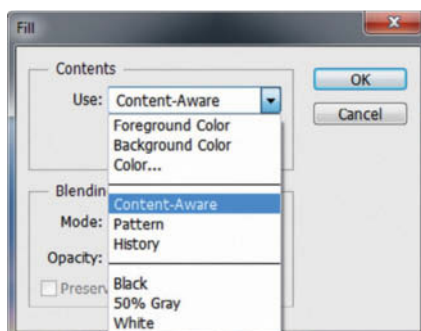
From a Pixel to an Object

To be able to manipulate image content, software has to be capable of recognizing different elements rather than just seeing an image as a random collection of pixels. In a two-dimensional image, a program can only differentiate between areas with different brightness, color or texture. This is why PatchMatch technology fails when faced with replacement tasks (such as replacing curved lines) that humans perceive as relatively simple. Although the human eye initially sees an image as a collection of different colors and degrees of brightness, our brain quickly switches in and

compares these apparently random patterns with ones saved in our memory and assigns appropriate objects to them.

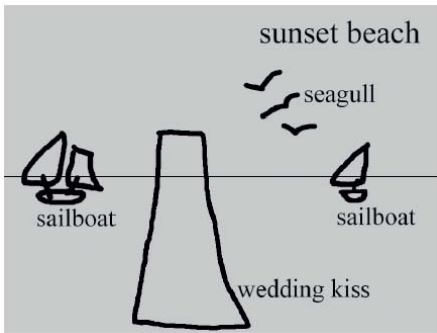
Such 'knowledge-based' recognition methods are not the exclusive preserve of humans, and they already provide reliable face recognition functionality in programs like *Photoshop Elements* and *Picasa*. However, it is much easier to simply recognize a face for what it is than to separate it from its 'non-facial' surroundings. Things become even more complex if we want to remove an object that partially covers a face and restore the

resulting areas to match. Simply duplicating neighboring pixels isn't sufficient, and software has to have prior knowledge of human anatomy or be capable of mirroring or copying similar nearby features to perform the task successfully. To make things even more complicated, subjects don't always look straight into the camera, so software has to extrapolate any information it recognizes into three dimensions. Generally speaking, object recognition is easier if depth-related data is available. Read on to find out how such information can be recorded and used.



A standard feature of many free and commercial image processing programs, the PatchMatch algorithm enables us to intervene almost undetected to move, remove and scale selected objects. The 'new' background is constructed from the pixels surrounding the moved object.





Chinese researchers have created an app (*Sketch2Photo* (<http://cg.cs.tsinghua.edu.cn/montage/>)) that shows it is possible to transform a sketch into a photo – at least in principle. *Sketch2Photo* analyzes the sketch and searches for appropriate elements on the Web, which it automatically inserts into the finished photo.

Hyper-real Images

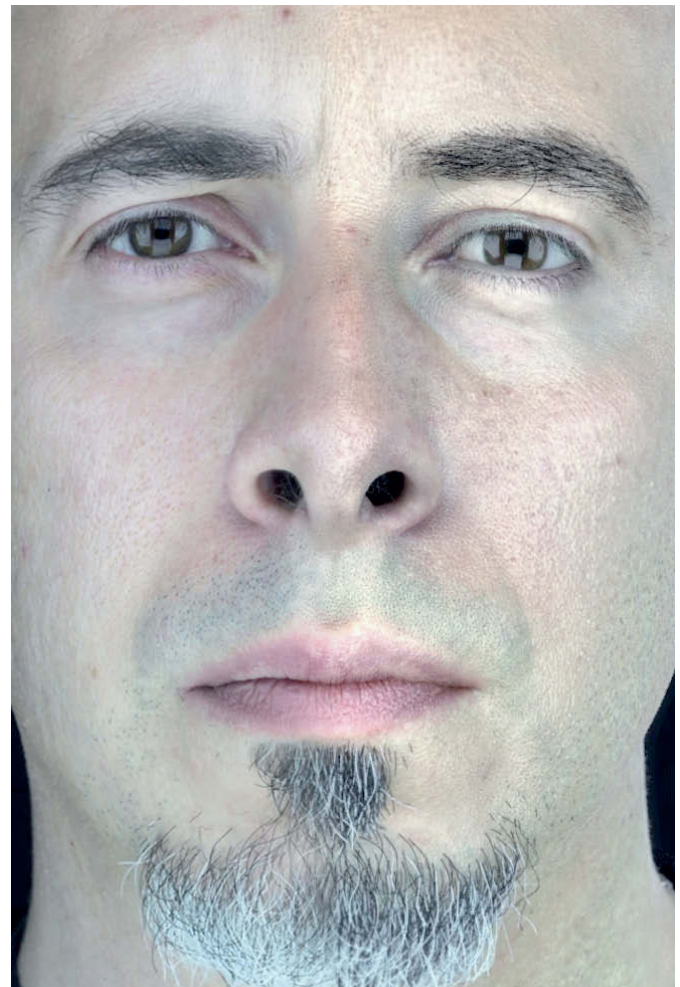
Object recognition is just one step on the way to producing ‘images’ that simulate photographed reality instead of just producing a two-dimensional copy, and two other aspects of this process have already become the state of the art. HDR imaging techniques can be used to convert bracketing sequences into single 32-bit images that contain the entire dynamic range originally present in a subject (see Issues 7 and 8 of *c’t Digital Photography* for more on HDR techniques and color management). Because a single source image can never capture the entire range of tonal values in a subject, an HDR (high dynamic range) image is, in fact, a small piece of virtual reality. Taking an HDR image as a basis, you can select a range of tonal values that you then use to create under- or overexposed ‘photos’ in which you can also manipulate the range of tonal values (using tone mapping techniques) to alter exposure and/or contrast. The effects you can achieve range from simulating fill flash to creating artificial lighting conditions that simply don’t exist in reality.

Just as HDR techniques are used to overcome the limited dynamic range that cameras can capture, panorama techniques can be used to create images with a much broader angle of view than any existing lens can capture. In a panorama, a series of source images are overlapped to form extended-view images that can cover the entire circular (or even spherical) field of view surrounding the photographer. Each element of a spherical panorama represents an individually created virtual photo with its own virtual angle of view. A detail taken from a spherical panorama has the same problem as any photo shot using a wide-angle lens or any map representing a section of the Earth’s surface, namely: distortion. If you are prepared to accept distortion as part of the overall effect, you can use panorama software to project an entire 360-degree

(or spherical) view into a single two-dimensional image according to the dictates of geometry and optics. The technique has its limitations, but nevertheless creates a scene that no camera can capture. These, often called ‘little planets’, are one of the most spectacular hyper-real image effects available to today’s digital photographers. See the title page of this article for an example.

Simulated Super-lenses

Panorama stitching techniques can be used to create images that appear realistic at a first glance but simply cannot be photographed using conventional equipment, due to ‘impossible’ viewpoints or lens geometry. ‘Bokehrama’ images (see Issue 12 of *c’t Digital Photography*) are a good example of this type of contradictory technique.



Hyper-reality in practice: can you see the difference? One half of this image is a photo and the other was rendered using KeyShot.

Image: Marco di Lucca



Stereographic projection of spherical panoramas can be used to create 'little planet' images, like this one of the German Chancellor's office in Berlin

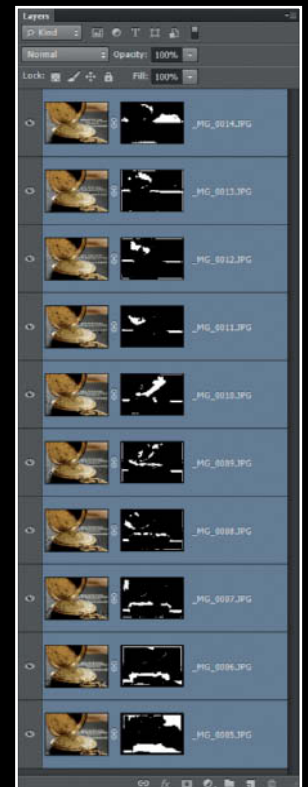
Stitching images together in a way that enhances the angle of view and pixel count but retains the shallow wide-angle depth of field, they simulate the effect of using a camera with an impossibly huge sensor. This approach makes it relatively simple to simulate DSLR or medium-format results using a compact camera. To produce such results using conventional equipment, the lens would have to have an extremely short focal length and a huge maximum aperture. Apertures of f1.0 and more can be simulated using this method, and even the absolute maximum of f0.25 is theoretically achievable. The online tool at <http://brettmaxwellphoto.com/Brenizer-Method-Calculation/> calculates the effective focal length and aperture of a 'bokehrama' image.

Aside from the the bokeh effects it can help you achieve, shooting multiple neighboring images is a great way to simulate

the effect of an ultra-wide-angle lens. Most stitching software is capable of compensating for the slight parallax errors that shooting handheld causes, and the result is an image with increased resolution. Shooting in precisely calculated increments using a telephoto lens, you can shoot the source material for 'gigapixel' images (see Issue 7 of *c't Digital Photography*), which you can then stitch together using dedicated software and a powerful computer. We are sure that the processing power built into modern digital cameras is capable of automatically aligning and stitching 10 or 12 images into a 'pseudo-ultra-wide-angle' shot, but we haven't yet heard of it being done. The 'sweep panorama' functionality built into many compact cameras and smartphones is a step in the right direction but not the high-quality solution we would prefer to see.

While bokehrama techniques aim to reduce depth of field, macro situations

require us to extract the greatest possible depth from a situation. Once again, sequences of source images come to the rescue, this time using the same camera position but differing focus settings from shot to shot. Specialized software is then used to extract the sharpest areas from each source image and merge them into a single image with enhanced depth of field. Camera do not provide any direct support for this technique either. The most complex aspect of the process, which could easily be automated, is precise sequential adjustment of the focus setting. The underused potential and 'hidden' functionality contained in many cameras has recently been revealed by determined camera hackers, most notably the creators of the *Canon Hack Development Kit* (CHDK) for Canon compacts (chdk.wikia.com) and *Magic Lantern* (www.magiclantern.fm) for a range of Canon DSLRs.



A sequence of images taken at slightly varying focus settings can be merged to form a single image with enhanced depth of field. This technique, called 'focus stacking', uses only the sharpest areas of each image in the final result. To achieve this effect, *Photoshop* creates 'hard' borders between the individual image areas (see the stacking sequence on the right), while other programs, such as *Helicon Focus*, use 'soft' transitions.





The ultra-wide-angle shot of the crowded church is a simple task for the software to master – panorama software has been able to create this kind of image for years. Our hero e-mails it to the local store, where he can collect his prints a few minutes later from the machine outside, even though it is Sunday and the store itself is closed. Thanks to his camera's 8K video format, he can also make some high-quality large-format prints from his footage of the party. The best bits show the bride's father falling into the wedding cake in a moment of high jinks. Moments like this can't be predicted, so it was just as well he was shooting in video mode, otherwise he would have missed the best photo opportunity of the day!

Photo/Video Synthesis

A video is really only a sequence of photos shot at high speed, and we are sure that these two media will soon merge into one. Burst shooting rates are getting faster all the time, and video formats are constantly increasing in size. The largest video format so far, 8K UHD TV, captures 7680 × 4320-pixel (33.2-megapixel) frames that exceed the resolution of most of today's high-end stills cameras. RAW and HDR, too, are no longer taboo terms in the world of digital video. Video shot with a DSLR uses only a fraction of the available sensor cells to capture each frame. The merging of the photo and video media will be complete when hard- and firmware are sufficiently well developed to capture full-sensor video

frames at today's frame rates. This change will enable publishers to use individual frames in multiple situations but will mean less work for TV and print journalists. Sport and action photographers will also be able to choose the best shot in a sequence and, provided that they start the sequence in time, will never have to miss another key shot again.

Casio has already taken the synthesis of photo and video capture to a new level with its 'Prerecord Movie' functionality, which feels like genuine moving picture magic. What actually happens is that the camera continually updates a buffer that stores up to five seconds of movie images. When you start movie recording, these images are stored,

followed by real-time movie recording, which means you never miss an important shot because you pressed the record button too late. Nikon has been quick to catch up with the 'Smart Photo Selector' built into the '1' series of cameras.

This kind of technology frees photography from its apparently immutable 'capture the moment' niche, and makes the actual moment at which you press the shutter button increasingly irrelevant. The negative side of this development is that photographers, rather than selecting shots carefully, keep up a kind of 'sustained fire' in the hope that one or other of the captured frames will fit the bill – a truly awful scenario for many photography enthusiasts.

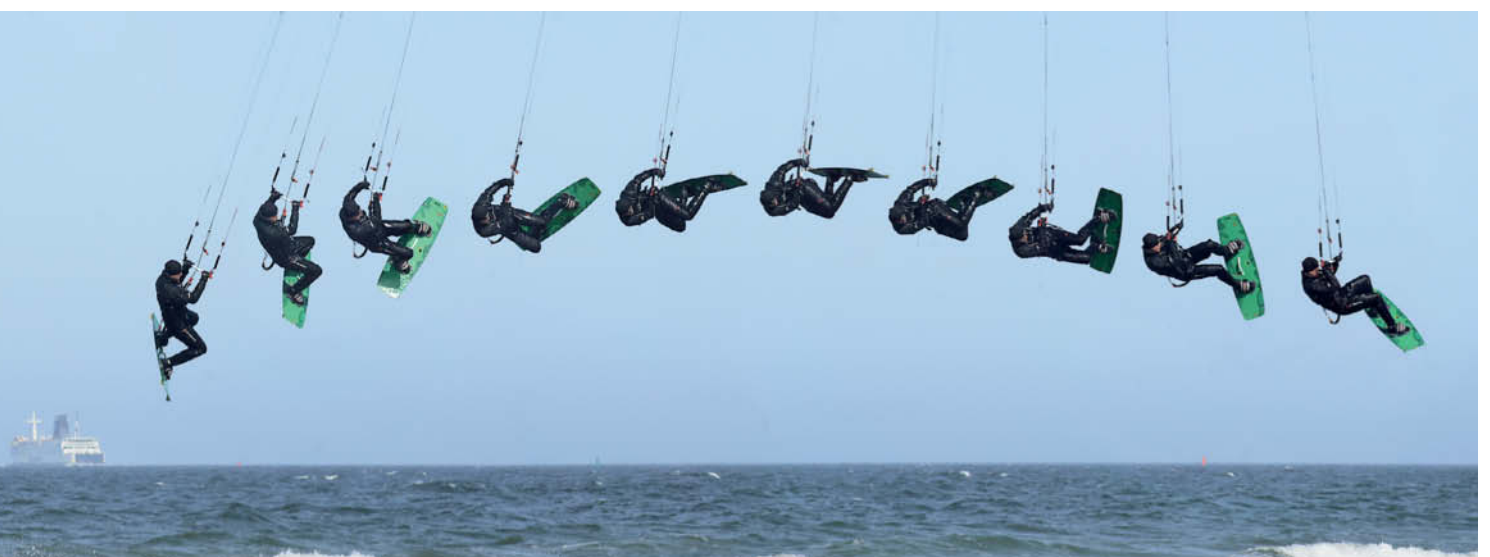


Photo meets Video: the 'Prerecord' mode built into some of Casio's Exilim cameras records burst sequences in the camera's internal memory buffer if you keep the shutter button pressed halfway, enabling you to record a clip and choose the best part later. Some cameras can merge the frames in a short video sequence into a single photo, enabling you to effectively capture movement in a still image, as shown here.



Although no-one ordered stereo images (the 3D hype of his youth only really took hold in the video arena), our hero is pleased with the depth map data his camera saved with each image. Now able to alter the focal point and the depth of field of his images at will, he immediately composes a few images with the bride and groom in focus and the rest of the scene nicely blurred. He uses simple two-finger gestures to draw the area that is to remain in focus, although he could just have set the appropriate distance and aperture settings on a virtual scale instead. and selects the shape of the aperture separately to produce a custom bokeh effect. Not until he saves a completely sharp group portrait alongside his more artistic efforts does he make the annoying discovery that his uncle apparently has eyes for his cousin rather than for the bridal couple in every shot. To rectify the situation, he simply selects his uncle's head and rotates it slightly.

The Third Dimension

Traditional photos are still limited by their two-dimensionality and their inability to suggest depth except by way of selectively placed blur. The usefulness of depth data goes way beyond the ability to create stereoscopic photos and videos (see Issue 5 of *c't Digital Photography*), for which the term 'three-dimensional' is something of a misnomer. Conventional '3D' images don't actually show the sides or back of the objects they represent, but the industry is working on this shortcoming too.

The first step toward recording true 3D image data is reliably capturing the distance between the sensor and the object reflecting the beams of light it records. Stereoscopic techniques are not suitable because they first have to find matching points in each partial image before the corresponding subject distance can be calculated by means of the offset between the two. True three-dimensional data recording requires a completely new approach to data capture. The techniques that exist today are based on capturing of sequences of images. The 'moving depth' approach (realized by the Microsoft Research 'KinectFusion' method, amongst others) involves moving the entire camera and extrapolating a 3D model of the surroundings from the detail shifts within the frame. 'Depth from focus' methods, which use a stationary camera and varying focus settings, are much more practical. In this case, the camera records maximum local sharpness values throughout the frame and uses them to calculate the distance between the camera and individual details. A kind of automated focus stacking, this concept is sure to win the approval of macro enthusiasts.

'Depth from defocus' methods are more ethereal and require the use of complex mathematical formulae to construct a

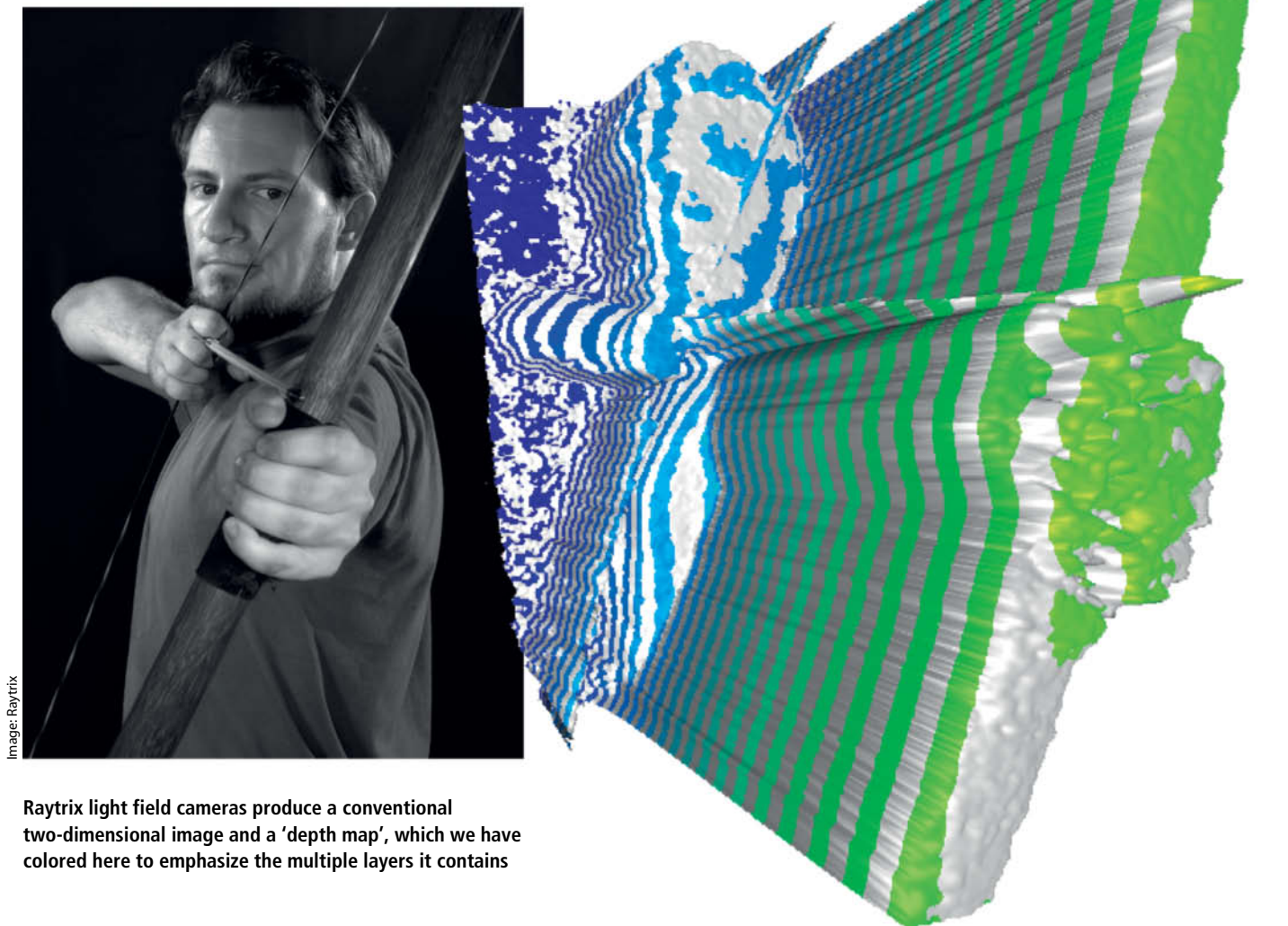
three-dimensional image using two or more differently focused source images. These methods compare the degree of blur produced by moving the sensor in tiny increments (usually a couple of tenths of a millimeter) along the optical axis of the lens – an approach that requires extremely sophisticated stabilizing technology. This little-known technology has been developed by Panasonic and is called 'Half-Sweep Imaging for Depth from Defocus'.

Active 3D capture with 'Time of Flight' (TOF) cameras measures the time taken by specially modulated LED light to be reflected from its surroundings on a pixel-by-pixel basis. Alternatively, the surroundings can be scanned using a laser beam, which takes longer but is more accurate. Both methods deliver a depth map in the form of a 'point cloud', making an additional conventional necessary photo for reference.



Image: Raytrix

Once captured, depth map data can be used to produce various views of an object. For this technique to work properly, the surface of each object has to be fully sampled. Details that are partially covered cannot be correctly reproduced, as the flower in this example shows.



Raytrix light field cameras produce a conventional two-dimensional image and a 'depth map', which we have colored here to emphasize the multiple layers it contains

Light Field Cameras

'Plenoptic' (or 'light field') cameras (see Issue 9 of *c't Digital Photography*), which are already commercially available for industrial customers (Raytrix) and end-users (Lytro) achieve the same effect in a similar way. Light entering this type of camera is captured by a conventional lens but passes through an array of microlenses positioned between the lens and the image sensor. The microlenses direct light arriving from different distances to different sensor cells, resulting in multiple images that provide visual and depth data corresponding to the details contained within the frame. The downside of the sheer amount of data this process requires is a reduction in resolution by a factor of at least four.

Once you have captured a sharp image and corresponding depth data for each pixel you can adjust the focal point and depth of field at will. Because it reproduces the nature and position of reflections and shadows

accurately, this technique can also be used to make realistic-looking adjustments to overall exposure. In fact, because the depth data for the structures within the image is known, you can even adjust the perspective and apparent shooting position in a light field image. This type of adjustment 'stretches' oblique surfaces and 'compresses' straight ones, occasionally reducing the quality of the corresponding details. While this method cannot, of course, 'look behind' objects, it can be used to 'rotate' them, as long as no important elements are completely covered up in the original image. Some missing detail can be retrieved using 'smart' interpolation technology like that built into the *Photoshop* Healing Brush tool.

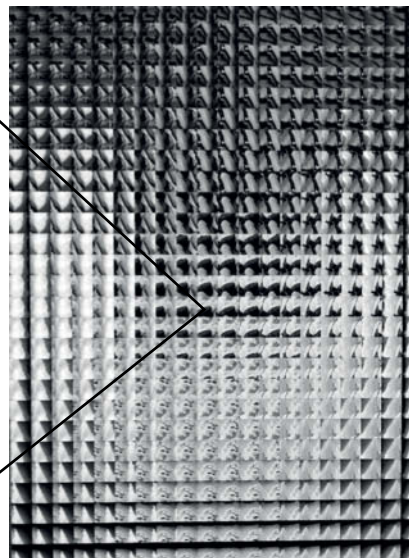
Depth data therefore gives photographers several new degrees of freedom. Pro film-makers have been waiting a long time to be able to adjust focus (or shifts in the plane of focus) after shooting. Such functionality would significantly reduce the number of bad

takes and the effort involved in getting a video shot 'in the can'.

Nevertheless, the light field principle is not the do-it-all solution for producing greater depth of field. Here too, the real obtainable depth of field depends on the aperture and focal length and the size of the sensor used to capture an image. Greater depth of field requires a small aperture, which necessarily reduces the amount of light entering the lens, thus making the sensor less sensitive. The lens built into the Lytro camera has a fixed aperture of f2 across its entire 43-350mm zoom range which, because of the small sensor, equates to an equivalent full-frame aperture of f10. But even this relatively small aperture cannot capture all distant detail in sharp focus. Raytrix cameras use three different types of microlenses optimized for different applications. The current generation of light field cameras uses conventional lenses to capture light, which makes their bodies quite bulky. Maybe this will change too.

High-end Light Field Imaging

Raytrix light field cameras are squarely aimed at industrial users. The current top-of-the-range R29 model has a 29-megapixel medium-format sensor that produces images with an effective resolution of 7.25 megapixels, which is simply not sufficient for a demanding shoot. Pro photographer Martin Haeusler has developed a technique that combines multiple DSLR and Raytrix cameras that shoot simultaneously. The DSLRs capture high-resolution stereoscopic images, while the Raytrix cameras capture the corresponding depth data. He then uses a powerful computer to produce spectacular 3D images of his subjects, which he prints at life size using lenticular techniques to preserve the 3D effect. As well as producing 3D images, Haeusler uses his



Light field cameras capture multiple images of the same scene at a slight offset (left), and can be used to create stereoscopic images, albeit with a very small stereo base and a correspondingly weak stereo effect. Martin Haeusler has developed a technique that employs multiple cameras to produce a much 'deeper' 3D effect. This is illustrated in the two images above, which you can 'merge' by looking 'through' them.

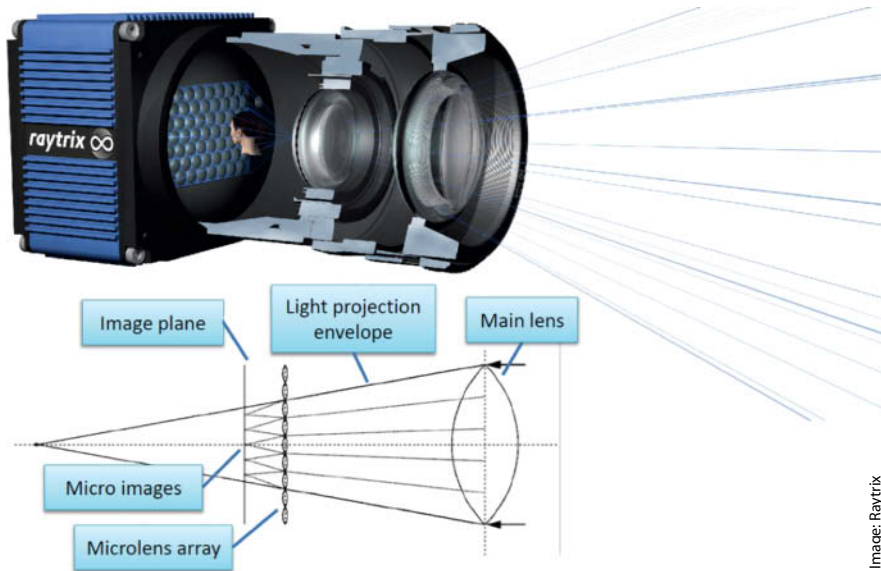
The two images below were focused after shooting. Focus is centered on the toe of the model's shoe in the left-hand image and shifts to her face in the right-hand one.

data to refocus images after shooting, as shown in the lower two images on the right.

He has also conducted experiments with his own 'microraster' light field devices, which he builds using components from several dismantled medium-format digital cameras. However, the quality of the resulting images is only sufficient if he uses custom microlens arrays and sensors, which are hugely expensive to build. Major camera manufacturers have shown some interest in the project, but have yet to commit any resources to further development. Haeusler's techniques will probably remain an exotic footnote in the history of 3D photography – unless, of course, an agile and ambitious company such as Lytro decides to take up the challenge.



Images: www.martinhaeusler.com



A light field camera uses a microlens array to separate the incoming image into multiple micro-images before it reaches the sensor. The offset between neighboring micro-images is then used to calculate the corresponding distance data.

Image: Raytrix

This approach has been realized using a huge circular array cameras with shutters that are fired simultaneously. The resulting 'bullet time effect' and was used to great effect in the 'Matrix' movies, where the film-makers used multiple stills cameras fired in sequence milliseconds after one another. The resulting images were then put together by a computer to produce an effect equivalent to a slow motion clip that had been decelerated by a factor of 500. The extremely accurate planning and preparation required make it almost impossible to alter perspective or focus after the event. Such finesse would only be possible if all the cameras in the array were used in burst or video capture mode.

Pans through 'frozen' or extreme slow-motion scenes are thus a question of how much hardware is available, and you can achieve similar effects at a fraction of the cost of the Hollywood version using video-equipped compact cameras. There is already some impressive footage on the Web of surfers captured using an array of waterproofed GoPro cameras, and you can even use a single high-speed camera to simulate the bullet time effect by moving it to follow the precise route taken by the subject. The technicians at the German special effects company The Marmalade (www.themarmalade.com) use an ultra-controllable robot arm mount to shoot slow-motion scenes.

Insect Eyes

Constructed to imitate insects' eyes, digital compound eyes also use microlenses to create multiple images on the camera's sensor. Because this approach doesn't require a lens large enough to illuminate the entire sensor, it can be used to build really slim cameras. The engineers at the Fraunhofer Institute of Applied Optics in Jena, Germany have managed to build a prototype digital compound eye that is just 1.4mm thick, which is ideal for use in smartphones and other portable applications. Because the partial images captured by the microlenses overlap even though they are captured from slightly differing perspectives, they can be used to produce enhanced-resolution images that include additional depth data.

Once again, using multiple lenses reduces image quality, and the prototype shown in the illustration below uses a 3-megapixel sensor to capture images with VGA (640x480-pixel) resolution. The Fraunhofer researchers have

already developed a similar sensor for capturing 720p video. The individual microlenses have a focal length of 0.8mm and the compound lens has an angle of view of 70 degrees (i.e., equivalent to a moderate wide-angle). The physics of the design prohibit the use of larger, smaller or zoomable angles of view, but nevertheless enable the construction of extremely flat cameras that do not require any moving parts to focus.

Matrix Calling

Whichever mathematical tricks and sophisticated optics you use, it is still impossible to create a true 3D image without looking at the backs of the objects you want to depict. The same is true of holography, which can only reproduce angles of view that have actually been recorded. In other words, if the photographer is to be freed of the restriction of a specific standpoint, the camera has to be able to capture data from every imaginable angle.

Schematic cross-section of a digital compound eye. The offset between the four aperture grids determines the angle of view for each microlens. The greater the parallax between neighboring images, the more accurate the resulting depth data.

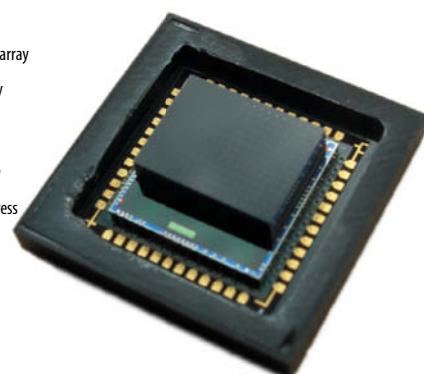
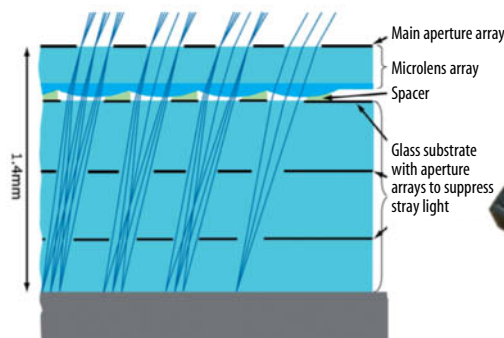


Image: IOF



Everything has gone pretty smoothly so far, although our hero is still rather embarrassed about missing the the actual high point of the day. But didn't he read somewhere about a new cloud service that automatically inserts photos into 3D scenes? ("This month only for our unbeatable tryout price!") He gets in touch with all the guests and asks them to upload their photos and videos to the wedding website. He quickly collects more than 50 GB of material and uploads it to the new service, selects the highest possible output resolution and pays US\$10. A few minutes later, he receives a download link to a five-second 3D video sequence made up of 2,000 individual images that can be viewed from every angle filmed by the party guests and slowed down at will. The online service has adjusted the color temperature, unified the image and video formats, automatically synchronized the soundtrack and even improved the image quality using super-resolution.

Cloud-based Services

Photoshop epitomizes the kind of high-end image processing software that most photographers would like to have, but is too expensive for many to consider. The program costs as much as a mid-range DSLR and comes in two versions, both of which have left their clientele feeling dissatisfied. The pro version includes an enormous range of tools and functions that no-one really uses to the full, while the much cheaper 'hobby' version of the program, *Photoshop Elements*, lacks some of the fundamental functionality that is essential to the modern image processing workflow. Nobody has yet come up with a pricing model that enables you purchase individual tools for a reasonable price, but things are changing rapidly in this respect too, and the future of image processing promises a world without conventional programs and a significant shift toward needs-based software usage and pricing. Before long, we probably won't have to actually install software on our own computers and will only pay for the functionality we really need.

Adobe's 'Creative Cloud' model has taken the first step in this direction, although the current approach only replaces the purchase of a conventional software license with a subscription payment model that includes cloud-based disk space. The only customers who really benefit from this model are pro users who always need the latest version of the software. Hobby and occasional users are faced with much higher costs and are obliged to subscribe to software that they don't need in order to have access to one or two basic functions. The ability to carry on using an old, amortized version of the program will disappear with time, and the market for used software is also destined to

vanish. The new approach turns software that can be bought and owned into a service that is only available for as long as the customer continues to pay, in the form of money or annoying adverts.

Even if it is stored in the cloud, Adobe software and the user's own data still have to be present on a local hard disk during use, whereas other image processing apps such as *Instagram*, *Hipstamatic* and *Pixlr* are designed with direct, cloud- and social network-based processing in mind. *Hipstamatic* is a kind of virtual toy camera that allows you to apply various lens and filter effects that give your images a deliberately down-market look. *Pixlr* takes a more serious approach, using Flash-based software to adjust the look of a limited range of image file types (PSD but no TIFF) in a browser window. It works with image files stored on the Web or locally and processing takes place (as of Flash version 10) on a local level, wherever the source images are stored. *Pixlr* is a full-blown image processing package with an interface that looks a lot like *Photoshop*. Adobe's flash-based *Photoshop Express* offers only automatic tools. The size of images that can be processed is also limited and the program sometimes scales images without warning.

The main advantage of browser-based processing software is that locally stored files don't have to be uploaded for processing and only the tools and effects you apply have to be transported via the Web. The limitations of Flash-based functionality make applications less agile when applied to images stored in the cloud and the range of functions you can use also depends on the computing power available

locally. Server-based 'back-end' image processing takes place on much more powerful computers, although these machines are shared by multiple users. The bandwidth joining a local machine to the cloud is still an issue, although the increasing capacity of everyday Internet connections should solve this particular problem within the next few years. Once image processing has been completely outsourced to the cloud, users will no longer have to deal with software installation, security updates and incompatibility issues. Who knows, in future our images may even be processed by poorly paid technicians in China or India instead of by complex software. Seriously – we have already come across magazine and book layout services that work this way.

As with so many other innovations, the increased freedom that cloud-based processing promises also creates new dependencies. Not everyone feels comfortable storing important image files in a place run by someone they don't know or at a company that could go broke or decide to use other people's images for its own purposes. *Instagram* – has already tried to include the right to use its members' images in its terms of business. It is also possible that, once the market is established and the initial hype is over, the remaining players will set their prices as they see fit.

Technological progress is freeing us from many of the hitherto intrinsic limitations of the photographic medium. The other side of this particular coin appears to imply that, in order to enjoy the resulting luxury, we users have to relinquish control of the tools we use. The 'Matrix' is creeping nearer! (anm) **ct**



Kumaran Herold

How to Shoot **Slow-motion Video** with a Compact Camera

It used to be complex and expensive to shoot the high-speed footage that slow-motion sequences are based on, but the digital revolution has changed all that. Now it's possible to shoot slow-motion clips on a budget, using compact cameras and easy-to-use software that give you great results without the need for professional know-how and specialized gear. To whet your appetite, we have included some sample sequences on the free DVD that comes with this issue. Read on to find out how to get started shooting your own 'slow-mo' videos.

Some movements, such as a snowboarder's monster air, are simply too fast to take in. Wouldn't it be great if you could rewind them and watch them again, step by step? Or how about that cannonball at the outdoor pool? That would make a great frame-by-frame sequence! Other events – your wedding kiss, for example – are ripe for viewing time and time again. Whether an emotional moment or a memorable event, some scenes simply look better if viewed unhurriedly and precisely – and slow motion is the answer.

Some camera manufacturers are beginning to build high-speed functionality into their products, enabling the user to shoot

at up to 1,000 frames per second (fps) and producing results that are usually quite presentable.

We got hold of a **BenQ G1**, a **Casio EX-ZR200** and an **Olympus TG-820**, and checked out the quality of the slow-motion footage they produce. As a comparison, we also captured some footage using a Canon EOS 60D and 'slowed it down' using *Twixtor*, a plug-in for various video editing applications, including *Premiere*, *After Effects* and *Final Cut*.

To help us compare the quality of the clips, we also shot some standard 25fps footage using a Canon EOS 5D Mark II and some

pro-grade slow-motion footage using a MegaVis SpeedCam from HSVision.

What is Slow Motion?

Most video clips – including HD – are shot and played back at a constant frame rate of 25 fps, which is fast enough to make subject and camera movements appear smooth and jump-free during viewing.

When a sequence is shown at a slower speed – for example, to analyze part of a sports event – each frame of the sequence is played back multiple times. This 'stop-and-go' process shows a series of snapshots with no



intermediate images to fill the gaps between the individual frames, resulting in shaky and unnatural-looking movements.

If we increase the capture frame rate, the camera shoots more frames per second (50 or 100 fps, for example). If these are played back at a 'normal' rate of 25fps, they appear to run in slow motion. The 'extra' frames fill the gaps and make the slowed-down movements in the clip appear smooth and detailed (see the illustration on page 110).

For example, if we shoot three seconds of 50fps footage of a ball thrown into the air and then play the clip back at 25 fps, it will last twice as long and the ball will appear to move half as fast as it did in reality. The action still appears smooth because we captured twice as many individual moments while the ball was in flight than we would have at a standard frame rate.

High-speed video is often used in industry to capture movements that are too fast to view normally. For example, when production line equipment is filmed at speeds of up to 2,000 fps the footage can be played back so slowly that any hitches in the machine's activity can be analyzed in detail and corrected as necessary. Specialized high-speed cameras are even capable of capturing the flight of a bullet fired from a gun – action that takes place at speeds of up to 4,000 km/h (see the sample video on this issue's free DVD). High-speed equipment is also used in advertising and movies to emphasize specific action.

Capturing ultra-high-frame-rate footage requires the use of high-end electronics, fast sensors and smart memory, and the 'high-speed' compacts we tested need to be developed a lot further before they can be compared with true high-speed gear. Instead of capturing footage at the usual 25 or 30 fps, the models we tested capture action at up to 120 fps or, in the case of the Casio, at up to 1,000 fps. However, such high speeds demand serious technical compromises.

If you want to include a slow-motion sequence in a clip shot at normal speed, it helps if your camera supports 'speed ramping', which involves switching to a preset (faster) frame rate during capture. This helps to keep transitions from one capture speed to another smooth and consistent.

Whichever equipment you use, high-speed shooting requires more light than conventional capture techniques. The time available to expose each individual frame decreases as the frame rate increases, so you need more light to achieve the same exposure. You can compensate to a degree by using a wider aperture, although compact cameras have fairly limited scope in this respect. This basically means that slow-motion sequences are best shot outdoors in sunlight.

Our Camera Test

Essentially, our test involved checking out how well 'high-speed' compacts deal with

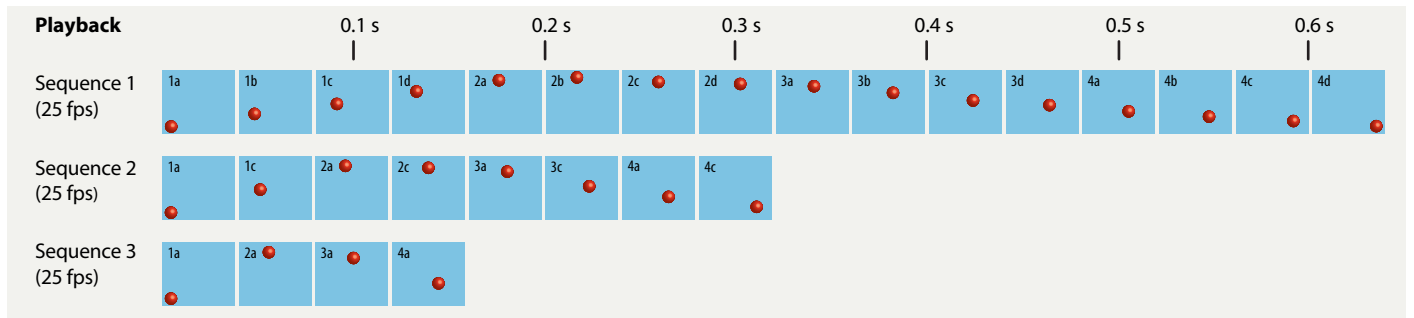
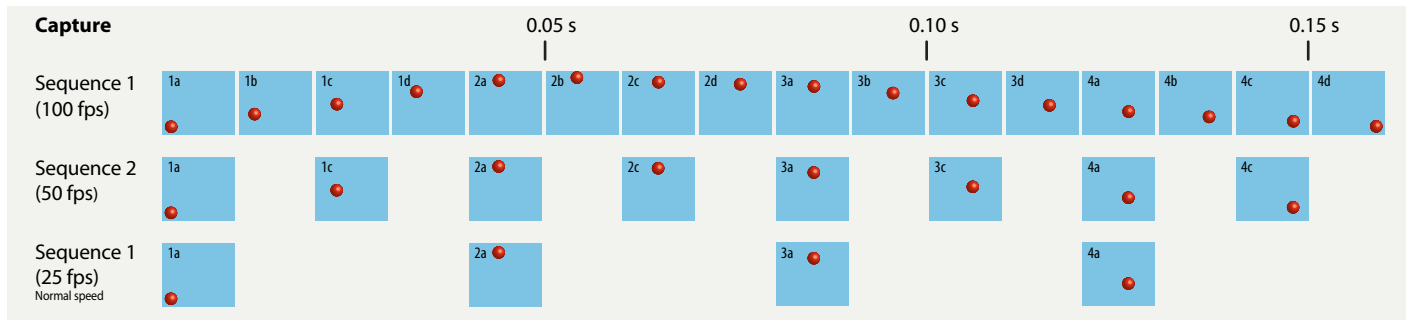
fast-moving subjects. We headed off to a skatepark with cross bikers Florian Faubel and Alexander 'Gismo' Reisdorff and set up our test cameras to capture various jumps simultaneously. Although it was complex to set up, this approach helped us to capture directly comparable footage with all five devices.

We shot our test clips at 120 fps, the highest frame rate supported by all the test compacts. The HSVision MegaVis SpeedCam, which can capture Full HD footage at up to 2,000 fps (and low-resolution footage up to 160,000 fps), served as our 'official' reference device.

We also had a Canon EOS 5D MK II running at 25 fps to help us judge overall image quality. The jumps we captured lasted about 1½ seconds in real time, so we were able to stretch the resulting clips to about six seconds in length at 120 fps.

The 60fps footage that we processed using *Twixtor* was shot using a Canon EOS 60D. For logistical reasons, we had to shoot this sequence on a different day, so it shows a slightly different scene from the others.

Comparing stills from a video clip is not a realistic way to compare the quality of the footage, so we have included all our test clips on this issue's DVD for you to view and compare at leisure. We have also included clips captured at between 1,000 and 160,000 fps using the MegaVis camera kindly loaned to us by HSVision.



A high-speed clip shot at 100 fps contains four times as many frames per unit time than the same clip shot at 25 fps. Playing the 100 fps sequence back at 25 fps results in a sequence that lasts four times as long as the original.

This shot shows our test setup in action. From left, the computer-controlled MegaVis, one of our DSLRs and the three compacts.





BenQ G1



Casio EX-ZR200

These screenshots are taken from the 120 fps high-speed sequences we shot using our test cameras and the comparison clip shot using our Canon EOS 5D MK II.

Because of their 4:3 VGA resolution, the BenQ G1 and the Casio EX-ZR200 offer conspicuously lower quality than the other cameras, which all capture 16:9 Full HD footage.

BenQ G1

BenQ's G1 produces colors that are much more saturated than those captured by any of the other models we looked at. The clips we captured nevertheless displayed blocky artifacts that are especially obvious in the asphalt in our test sequence. As well as producing relatively high levels of noise and stripe artifacts in the clouds, the camera had trouble metering for backlight. The footage is generally very high-contrast, lacks shadow detail and shows obvious blooming at high-contrast edges. In spite of these shortcomings, at 120fps the G1 produced acceptably smooth slow-motion clips with good detail.

The BenQ has just one high-speed frame rate and, like the Casio, captures VGA video with a 4:3 aspect ratio. The image size is set automatically to 640×480 and sound is turned off when you switch to high-speed mode.



Olympus TG-820



HSVision MegaVis



Canon EOS 5D MK II

Slow-motion Software

Twixtor is a plug-in designed for creating speed-adjusted sequences from video clips shot at normal speed. It is available as a free trial version at revisionfx.com and for US\$330 at the manufacturer's online store. The trial version inserts a watermark into processed clips.

To create a high-speed clip from normal footage, *Twixtor* generates new frames for insertion between the existing ones by tracking the movements present in the action. This 'motion estimation' is easier to achieve for simple, straightforward movements but quickly reaches its limits when confronted with complex or multi-directional action.

The plug-in is compatible with a range of popular editing applications and we generated our sample sequence using Adobe *Premiere*. The process is simple, but the quality of the results depends very much on the frame rate of your original material.

Our original clip was shot at 60 fps in 1280×720-pixel HD. Our experiments showed that footage shot at 25 fps showed more obvious artifacts once processed than footage shot at a faster frame rate, especially if the original clip contained complex background detail or movements. This is because the software has to generate more 'in-between' frames for complex source material.

The following sections describe the steps necessary to convert an original clip into a slow-motion sequence using *Twixtor*.

Once you have imported your original material, open a new sequence with an appropriate name ('original_material' for example) and drag it to the timeline.

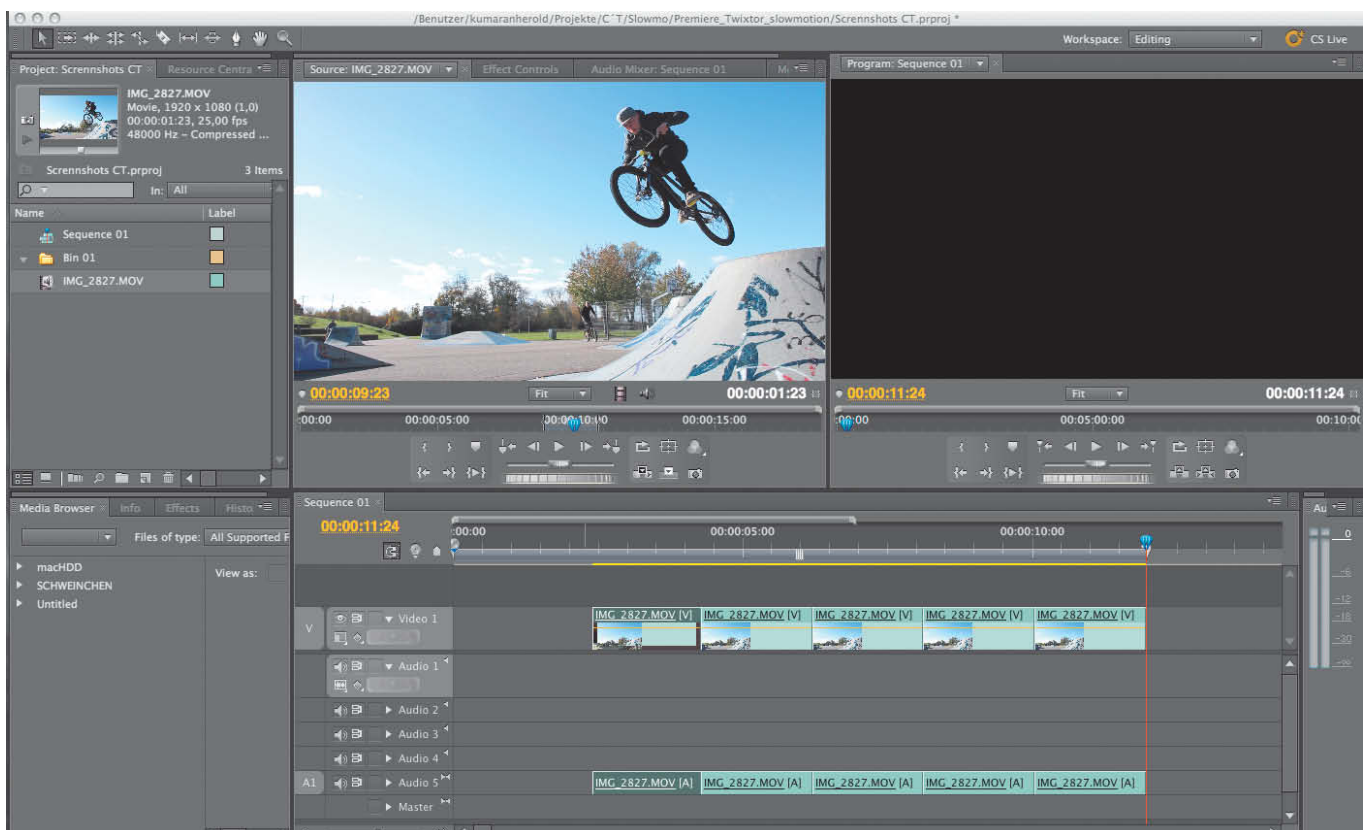
Generating the new frames takes a lot of computing power, so it is advisable to select just a small portion of the original film for conversion. To do this, generate a selection from your chosen excerpt, copy it

and insert it several times into the timeline. The total length of the copied excerpts determines the length of the resulting slow-motion sequence.

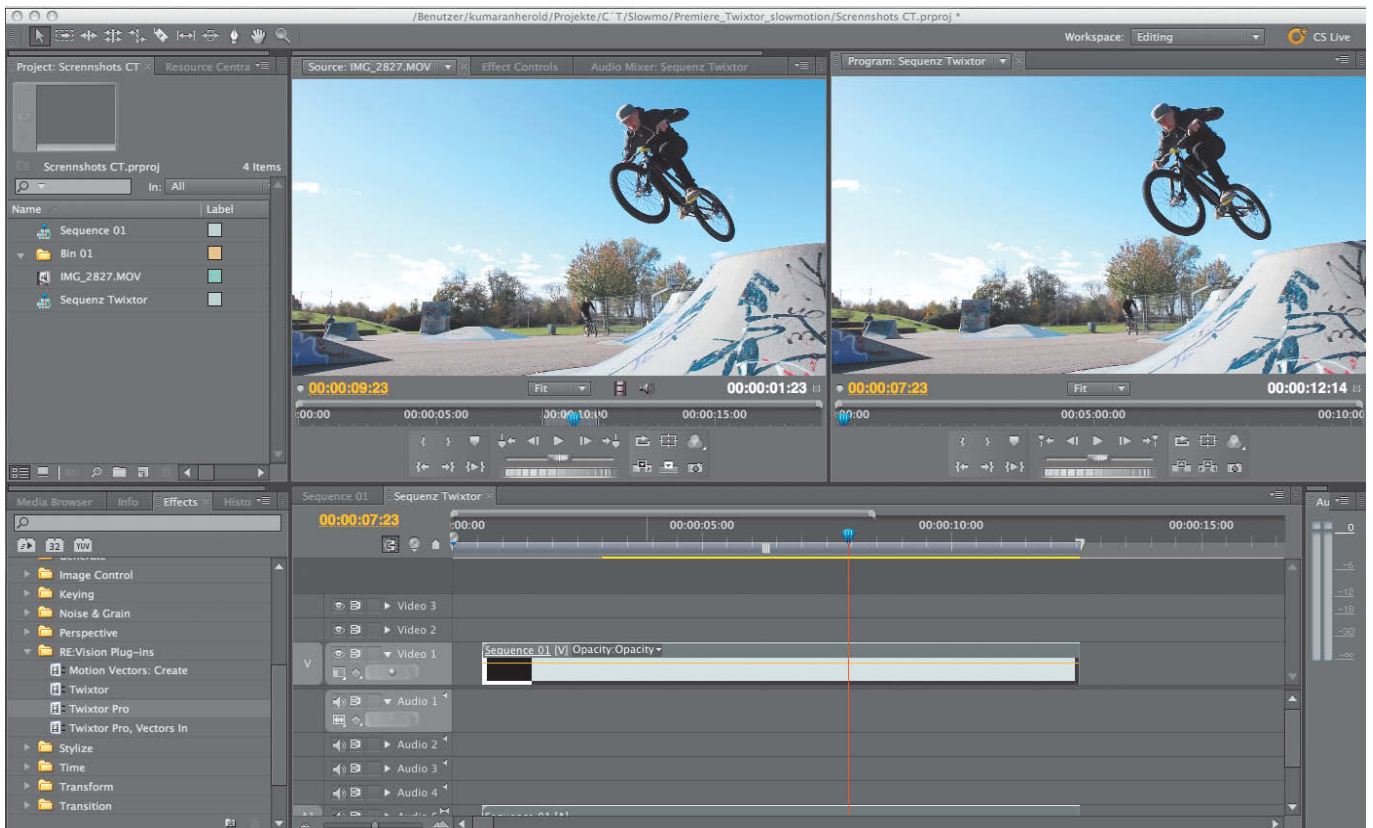
Now open another new sequence and name it 'twixtor' (or something else appropriate) and drag the 'original_material' sequence to the 'twixtor' timeline. The raw material is then displayed as a single new clip. Now select *Twixtor* from the Effects panel (at bottom left) and drag it to the clip in the timeline.

You can now customize the effect's tool settings. Make sure that the *Input Field* option is set to *None*. Speed is set using the *Output Control* options – the Default setting is 100% (i.e., the original speed), so setting it to 50% will create a new sequence at half speed.

Once you have made your settings, the new sequence can be rendered using the



The selection for the slow-motion sequence is copied multiple times to the timeline and the total length determines the length of the resulting clip



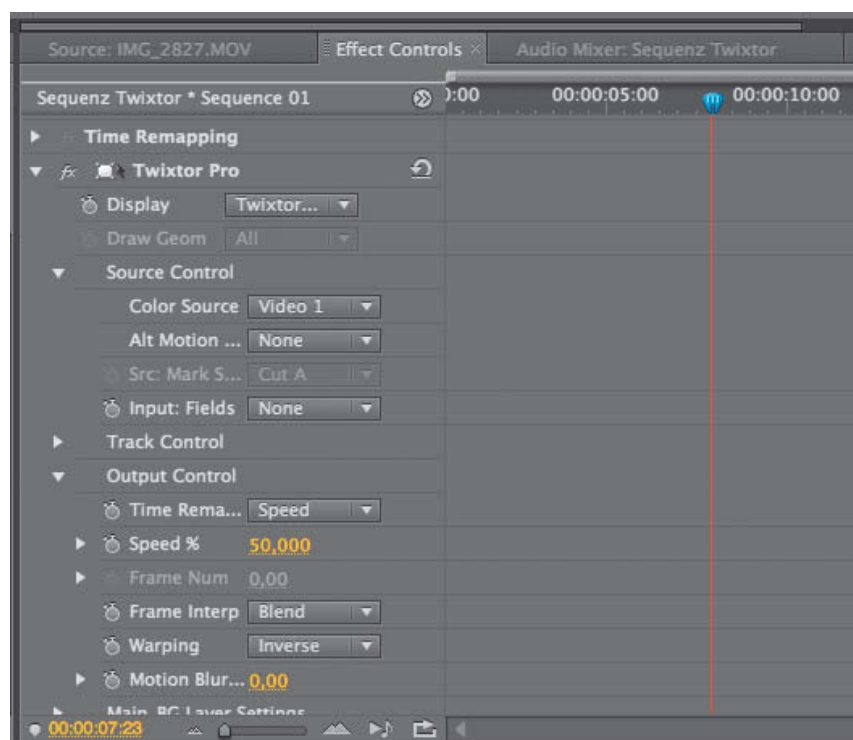
Once you have created a new sequence you can apply the *Twixtor* effect to it. The new slow-motion sequence then appears next to the original in the program window.

Sequence > Render Effects in Work Area command.

If the new clip repeats itself, this means that the copied clips were too long. The simplest solution here is to edit out the part of the rendered clip that you need. If the new clip is too short, you will have to increase the number of clips in the 'original_material' sequence and repeat the rendering process.

Each new clip presents *Twixtor* with a unique set of challenges, so you will have to experiment with the output options until you find the combination that produces the effect you are looking for.

There are various parameters you can adjust to optimize the look of the final slow-motion sequence





The BenQ G1 captures VGA clips at 120 fps. The resulting slow-motion sequences are smooth and detailed, although they do include some blocky artifacts.



The Casio EX-ZR200 captures clean VGA slow-motion clips and support speed ramping. Its overall video quality is acceptable.

When you switch to high-speed mode, the camera takes a quick break and displays a black monitor image before starting the actual capture process, making it unsuitable for capturing spontaneous slow-motion clips. As with the Casio, the BenQ firmware sets the aperture and focus settings automatically before you begin shooting, but does allow you to check your results immediately on the camera monitor.

Casio EX-ZR200

Casio's slow-motion effect is extremely good, offering high image quality in spite of relatively low (640x480) resolution and overly high contrast. Its high-speed frame rate can be set to one of four speeds between 120 and 1,000 fps, although resolution decreases steadily with increasing speed. At 1,000 fps, resolution is a measly 224x64 pixels.

Apart from the material shot at the default (30fps) frame rate, which can be played back in 16:9 Full HD, the Casio's other frame rates can only be played back using a 4:3 aspect ratio. The EX-ZR200 is the only compact we tested that offers built-in speed ramping, and

its two settings (HS 30-240 and HS 30-120) ensure smooth transitions between normal footage and slow-mo sequences.

Sound is automatically switched off while shooting in high-speed mode, although the 30fps parts of ramped sequences still record sound.

Reaction time when switching to high-speed mode is less than one second, which compares favorably with the other compacts and makes it possible to shoot spontaneous high-speed clips when an opportunity arises.

Focus can no longer be adjusted once you have started shooting a high-speed sequence, and aperture and focus are both set automatically. The results are available for in-camera viewing immediately after shooting.

Olympus TG-820

In contrast to the other two compacts, the Olympus TG-820 doesn't save its high-speed sequences as movies, but instead saves a sequence of 100 3-megapixel images shot at an equivalent frame rate of about 60 fps. The camera takes several seconds to save a

sequence before it is ready to shoot another.

The recorded images have to be turned into a video clip using computer-based software such as *Quicktime 7 Pro* or *Premiere Elements*. A sequence of 100 source images played back at 25 fps equate to a four-second slow-motion clip. This means that the TG-820 is only suitable for capturing short sequences and requires more precise timing than the other two compacts if you want to be sure of capturing the right moment. The longer sequences captured by the BenQ and the Casio enable you to edit your sequence to length post-shoot.

On the upside, the Olympus multi-image approach allows you to create sequences in 16:9 Full HD quality, resulting in the best slow-motion clip quality in our test. Its contrast characteristics are very good and the clips show good detail throughout the frame.

The relatively slow frame rate of 60 fps means that the Olympus slow-motion effect is not as pronounced as the one produced by the other two cameras. The monitor can only display individual images from the sequence, and moving pictures are only available once they have been processed on a computer.



The Olympus TG-820 shoots a sequence of 100 3-megapixel images that you have to convert to video on a computer. This approach means that the resulting clips are very short.

We used the pro-grade MegaVis from HSVision to shoot reference material. This high-end device can capture Full HD footage at up to 2,128 fps.



HSVision MegaVis

The MegaVis served as our reference camera, and delivered top-notch slow-motion sequences to compare with our test sequences. This pro-grade machine delivered clips of much higher quality than our test compacts, with less noise, greater dynamic range and stepless shooting speeds of up to 2,128 fps at Full HD (1920×1080) resolution.

The MegaVis is controlled via a laptop using custom software, and clips are saved as a sequence of individual RAW images that are converted to TIFF format before being merged into a single sequence. This takes longer than direct capture, but provides a greater range of exposure settings and the ability to adjust colors and tonal values after shooting. This high-end device was designed for industrial and commercial use and is often used to produce advertising and music videos. Complex handling and prices that start at around US\$75,000 make it suitable for professionally-shot clips but not for spontaneous, everyday use.

Canon EOS 60D with Twixtor

A combination of homogeneous backgrounds, high frame rates and short exposure times (to avoid motion blur) produced perfectly good results from all of our test compacts. *Twixtor* is a great alternative way to achieve similar results, allowing the user to set the playback speed and generate speed ramps after a clip has been captured. Processing footage takes time, and you have to be willing to experiment with the program's various parameters if you want to get the best out of the software (see the *Slow-motion Software* section on page 114). We processed our test sequence once using a speed setting of 50% (i.e., half the original speed) and again using a setting of 20% (one fifth speed). The resulting clips show no appreciable loss of quality compared to the



We shot a sequence at 60 fps with our EOS 60D and slowed it down using the *Twixtor* plug-in with Adobe *Premiere*

original, although the program had some issues when dealing with extreme movements. In such cases, the extra frames that were generated to fill the gaps between the originals were not generated cleanly and produced artifacts at the bottom edge of the frame, creating an effect that is similar to that produced by early flat-screen TVs.

Conclusions

To capture high-speed video successfully, the sensor in a compact camera has to be capable of reading and saving data faster than it does when shooting in 'normal' video mode. To make this possible, our compact test models scrim on resolution, leaving us with a mere 640×480 pixels (4:3) at 120 fps. The main effect of this reduction in quality is a corresponding lack of quality in the slowed-down clip. Viewed enlarged on a TV

screen, the clips showed obvious noise and other artifacts. Generally, the clips shot using the compacts are fine if viewed in a small window on YouTube or other Web platforms.

Other than that, our slow-motion clips displayed smooth, detailed movements that were easy to follow in spite of the auto-only shooting settings the cameras use.

The *Twixtor* results are generally not as smooth as the 'real' in-camera clips, but there are various options for tweaking your material once it is in the bag. The only prerequisite is that the footage you process is captured using a high-quality camera. The software also supports the generation of custom speed ramps. The only real downside is its US\$330 price tag.

For photo enthusiasts, slow-motion video clips are an interesting and creative way to enhance sequences of still images, and they also make a fun addition to anyone's everyday photographic repertoire. (pen)

HIGHSPEED VIDEO CAPTURE					
Manufacturer	BenQ	Casio	Olympus	HSVision	RE:Vision/Canon
Model	G1	EX-ZR200	TG-820	MegaVis	Twixtor/EOS 60D
Sensor size	1/2.3" (CMOS)	1/2.3" (CMOS)	1/2.3" (CMOS)	22.2 × 22.2 mm	APS-C (CMOS)
Stills resolution	14 megapixels	16.1 megapixels	12 megapixels	4 megapixels	18 megapixels
Lens	24-110 mm	24-300 mm	28-140 mm	Interchangeable (Nikon F)	Interchangeable
Max. video resolution	1920 × 1080 / 30 fps	1920 × 1080 / 30 fps	1920 × 1080 / 30 fps	2016 × 2016 / 1102 fps	1920 × 1080 / 30 fps, 1280 × 720 / 60 fps
High-speed frame rates	60 fps, 120 fps	120 fps, 240 fps, 480 fps, 1000 fps	60 fps (for approx. 2 s)	40 fps – 161,290 fps steplessly variable	Variable via software settings
Speed ramping	–	30 > 120 fps, 30 > 240 fps	–	Custom, stepless	Custom, stepless
Resolution at 120 fps	640 × 480	640 × 480	1920 × 1080 (60 fps)	2016 × 2016	1280 × 720
High-speed aspect ratio	4:3	4:3	16:9	1:1 or 16:9	16:9
Direct high-speed playback	✓	✓	–	✓	not applicable
Price (approx.)	US\$280	US\$230	US\$230	US\$75,000	US\$330 (software), US\$900 (camera)
✓ included	– not included				

Torsten Andreas Hoffmann

Composing with Color

Shooting color photos means using the using the endless colors of life to capture a balanced image. The only way to succeed is to consciously manipulate shape and color like a painter, and this article tells you how.

Vast numbers of people around the world take photos every day, but only rarely does anyone take the time to consider the visual language that each image 'speaks' – a language that follows virtually the same rules as classical painting. Photographers who wish to compose their images this way face an enormous challenge in that the myriad colors that make up everyday life often look chaotic and discordant if they are simply recorded without regard for composition. Success in color photography depends on finding excerpts from reality that present balanced

shapes and colors and a minimum of superfluous detail.

This article demonstrates the similarities between well-composed photographs and paintings, whether the colors they contain are 'loud' and expressionistic (i.e., the primary and secondary colors blue, red, yellow, green, orange and violet), or 'quiet' and subtle.

The most colorful photo is not necessarily the best, because it is the juxtaposition of the shapes and colors in an image that will determine whether it is a triumph or a flop.

The following pages go into the theory and practice of producing great color photos.





Colors Trigger Emotions

Colors are not merely instances of electromagnetic radiation with wavelengths between 380nm (ultraviolet) and 780 nm (infrared), they also have a powerful effect on the psyche of both humans and animals. Tests have shown, for example, that a racehorse will unwind much more quickly after a race if it is taken to a room that is painted blue rather than red.

Red: It is well known that looking at the color red boosts activity in the vegetative nervous system. The color of blood, red is also traditionally seen as the color of love and, in some cultures, the color of evil. A highly symbolic color, it is often used in royal

garments, left-leaning political scenarios and many other everyday situations that immediately attract our attention.

Green: The painter Vassily Kandinsky described green as “the most restful color ... self-satisfied, immovable and narrow.”

Blue represents calm and relaxation too, but also melancholy. In musical terms, if red and yellow represent the major scale, blue and violet clearly embody minor tones. Blue symbolizes restfulness, loyalty and trust. It is a matriarchal color that stands for the bond between mother and child and is often used for clothing in paintings of the Virgin Mary.

Violet represents an escalation of blue to a mystical, almost sacred color. Studies have shown that violet is a favorite color among ancient cultures such as that of the indigenous peoples of central Brazil.

Yellow and **Orange** are the most joyful colors and create a warm, cheerful and cozy mood. Yellow is, after all, the symbolic color of hope.

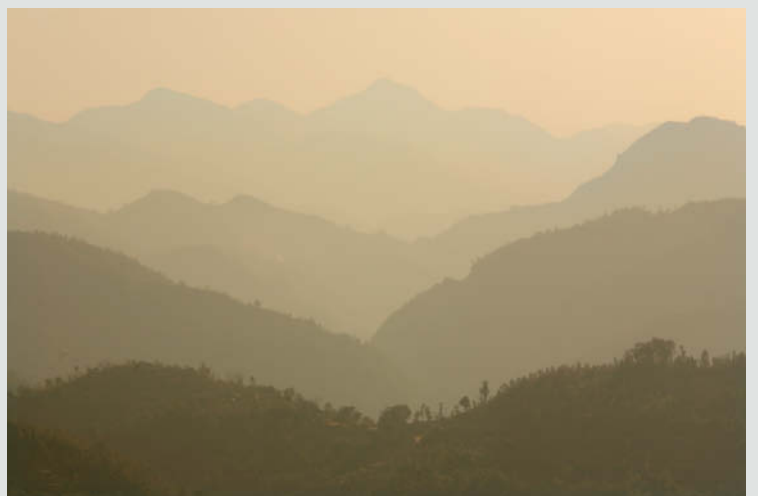
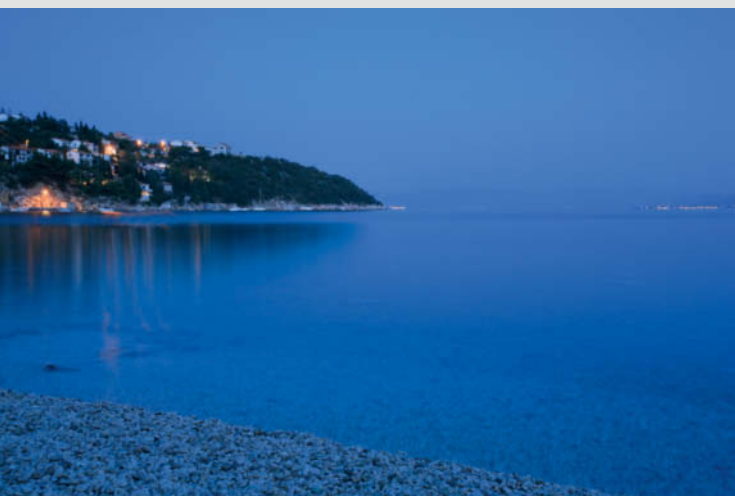
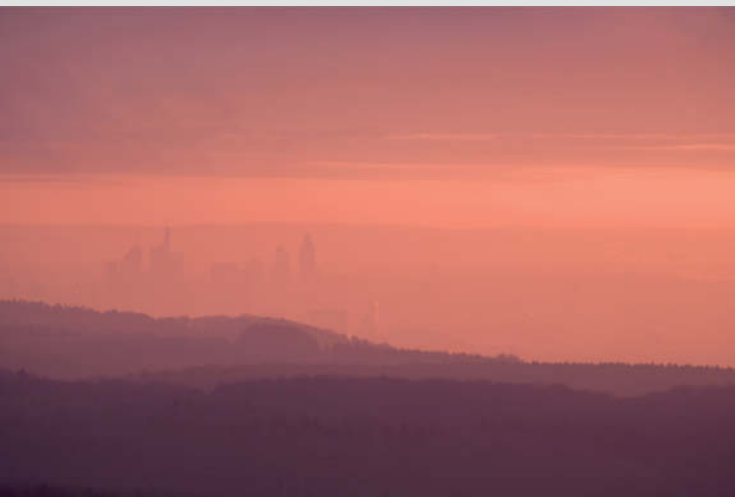
Understanding how colors affect the viewer’s state of mind is a great aid to effective photographic composition – for example, to help associate a particular mood with a certain product or brand.



The robes worn by Buddhist monks are often colored a deep red similar to that of Roman dignitaries’ togas. Combined with yellow and orange, this produces a dignified but also friendly and cheerful effect.

Red is the most stimulating color in the visible spectrum. This photo of the sky above Kathmandu is quite dramatic and combining red with black helps prevent it becoming kitschy. We will go into why most red-tinged sunrises and sunsets look clichéd later on.





Many people are unaware of the extent to which colors can affect their state of mind. Red is the most stimulating color, yellow the most joyful, green the calmest and violet the one that best suggests depth. Blue can produce a sense of melancholy, while orange – like yellow – embodies vitality.

How Color Contrast Works

Colors can be combined harmoniously but can also clash with one another. The color wheel invented by Swiss painter, designer and Bauhaus lecturer Johannes Itten helps to identify which of these scenarios will be the case.

Itten's invention is a schematic representation of the three primary colors (red, yellow and blue), the three secondary colors (orange, green and violet) produced by

combining two primaries and the six tertiary colors obtained by mixing primary and secondary colors.

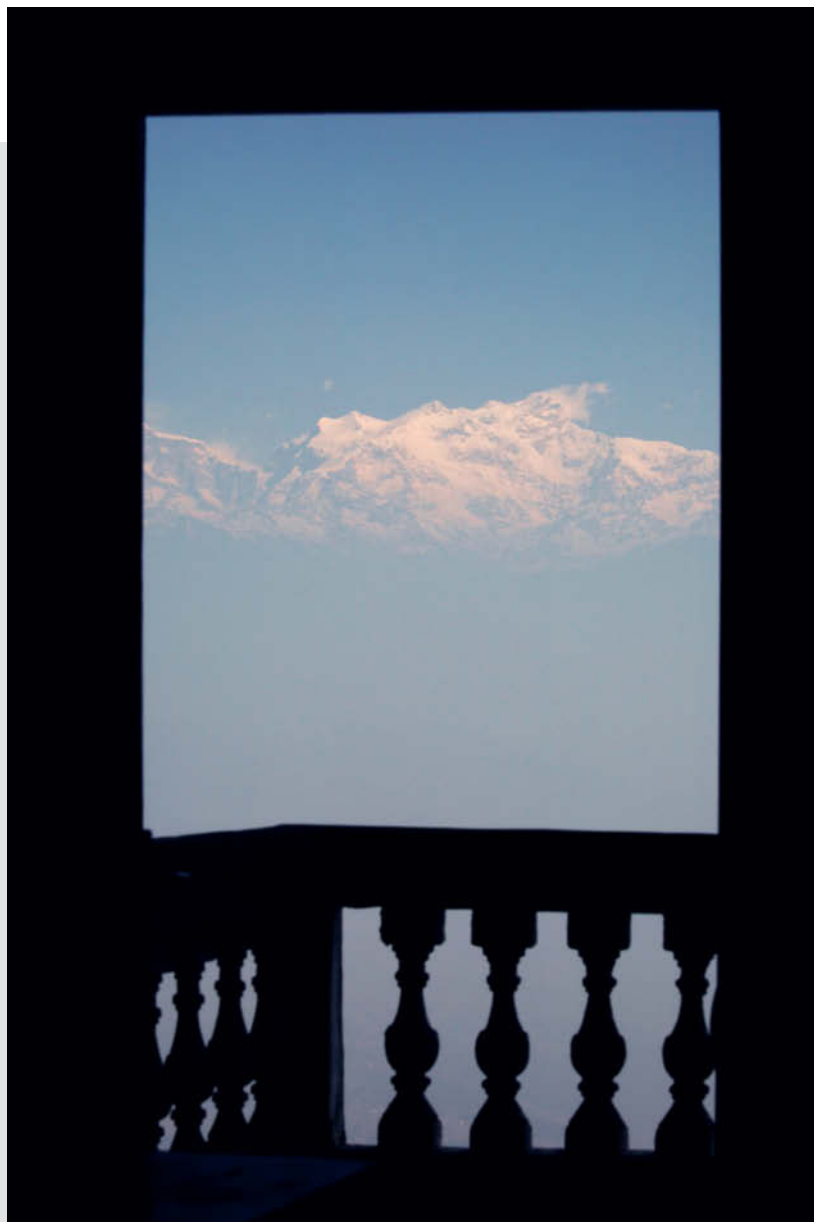
Itten is also credited with inventing the color contrast theory illustrated below. The examples on this page demonstrate the principles of cool/warm and complementary color contrast, while those opposite demonstrate qualitative and quantitative contrast.

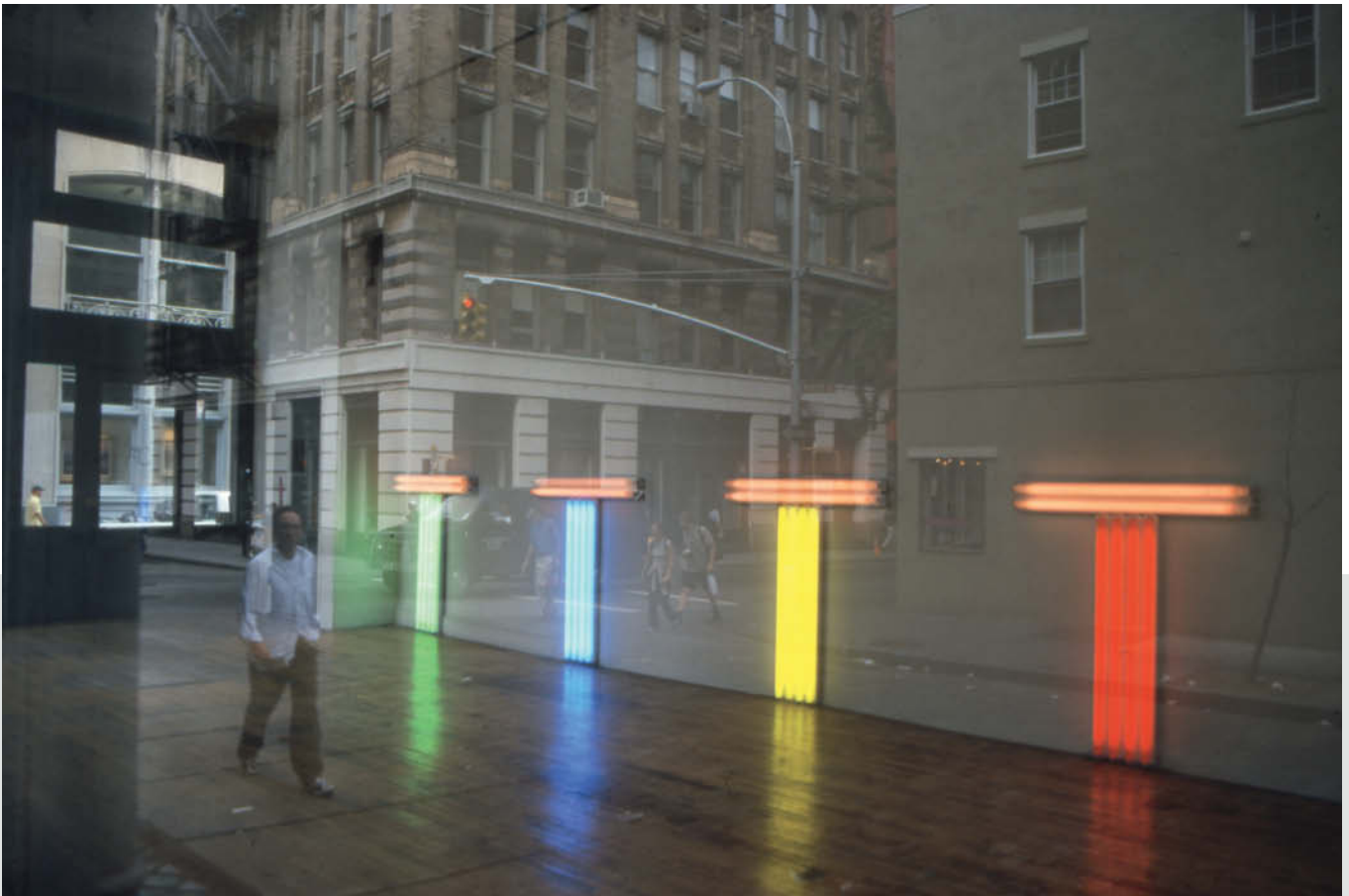


Johannes Itten's 'Farbkreis' (color wheel) shows the relationships between primary, secondary and tertiary colors



The image on the right shows the summit of Mount Annapurna in the Himalayas. The orange-tinged sunlight and the blue of the sky demonstrate the principle of cool/warm color contrast. This is also an example of complementary contrast, as the two colors are located on opposite sides of the color wheel. The smaller image above also contains a complementary contrast between the purple of the door and the yellow of the wall. Goethe's Theory of Color speaks of the human need for visual perfection and designates complementary colors as opposites that provide 'perfect' colors when mixed. This theory is backed up by experience, which shows that if we look at a color for long enough, our mind really does convince us that we are also looking at its complementary color.





Qualitative contrast occurs when pure and impure colors are juxtaposed. Pure colors are brighter than impure colors and thus dominate where both are present. This means that a small area of pure color is much more striking than a larger area of impure color that surrounds it. In the image above, for example, the neon artworks are much more obvious than their surroundings even though they are quite small.



These two images show examples of quantitative contrast between yellow and blue. In the left-hand image, yellow is spatially and therefore also visually dominant, while the right-hand image shows a balanced contrast between the yellow of the taxi and the blue of the early evening light.

Quantitative contrast is based on the strength, and consequent dominance, of a specific color or colors. The effect is caused by the amount of physical space taken up by the dominant color and the relationship between the strengths of the colors involved. Pairs of colors have varying relative strengths and can be roughly expressed in numbers as follows: yellow = 9, orange = 8, red = 6, green = 6, blue = 4 and violet = 3.

The Color of Light

Considered theoretically, a photographer's task is to create interesting compositions using the colors of the visible spectrum. To do so successfully, it is essential to understand how fundamentally the time of day, the weather and the season affect the impact of a color photo. Daylight can have a whole range of color temperatures. Its orange component is

particularly strong at sunrise and sunset, while the periods just before sunrise and just after sunset are dominated by cooler blue tones.

Cloudy or overcast weather produces the most accurate color rendition and is the favorite of artists who wish to 'objectify' their subjects as much as possible. On the other hand, midday sunlight and blue sky have a

much stronger blue component and often makes objects look pale and lifeless.

You can always use software to alter the color temperature of an image after shooting, but this often produces unnatural-looking results. It is always more effective to keep an eye out for particular lighting moods and use them deliberately to create a specific effect.

Below: In the Hoggar Mountains in Algeria, different light produces two completely different effects. The soft orange glow lighting the basalt of the mountains looks almost like bold brush strokes. The setting sun gives the forbidding landscape a magical look that belies its true nature.

Another way to make this landscape seem benign is to use backlight at sunrise. In the second photo, the same scene is bathed in blue-tinged early morning sunlight shining through thin cirrostratus clouds. The resulting effect is quite other-worldly and is much less 'gushing' than traditional sunrise or sunset compositions.



Above: Unusual moods created by cloud and sunlight such as this scene in Kathmandu, Nepal, are extremely short-lived and have to be captured the moment they occur. Always take a quick handheld shot the moment you see such a scene, even if the exposure parameters aren't perfect. A steady hand and a wide-angle lens set to its maximum aperture can be used to capture spontaneous moments in sufficient detail. If the situation allows, you can then take your time to compose a more structured image using a tripod and a smaller aperture.

Tone on Tone

We have already seen that it doesn't always make sense to shoot ultra-colorful images – color photography is much more about using the camera to filter reality so that the final image comprises a consciously composed set of colors. The well-known photographer Robert Haeusser once said that painting is an additive imaging process that compounds colors and shapes to produce the final image, whereas photography is a subtractive art form

that selectively extracts shapes and colors from reality. In other words, we aim to capture a range of colors that are located very close to one another on the color wheel. Many classical painters were aware of the effectiveness of painting with just one or two main colors. Rembrandt is famous for his exploration of an amazing range of brown tones that he used to frame his brightly lit subjects, and Caravaggio and Rubens took a

similar approach. Modern artist Antoni Tàpies covered huge canvases with subtle blends of earthy tones.

It is difficult to achieve such a degree of abstraction in a photographic context, as it involves freeing oneself from the material world and extracting shapes and colors from reality to form cohesive, visually satisfying images. The images below show two examples of this approach.

Right: When shooting landscapes in color, the dominant blue of the sky often makes it difficult to escape from postcard-style clichés. One way out is to use a 'tone on tone' composition, like this one of a vineyard in Heppenheim, Germany. The vines are covered with blue netting to protect them from marauding birds, and the artificial blue tones combine perfectly with the natural color of the sky to provide a fresh take on a familiar subject.



Left: This shot, captured on the island of Lanzarote, makes use of a range of brown and ochre tones combined with subtle highlights in green and an orange sky. The way the additional colors only become apparent at a second glance is exactly what makes 'tone on tone' compositions so appealing.

César Manrique, Lanzarote's most famous artist, once said that his home plays host to an endless range of shades of black.

Using Colored Accents

The addition of a single colored detail can make images composed using largely low-key colors much more effective.

It is never easy to filter the chaos of the everyday world to compose an image with precisely the right detail in exactly the right place within the frame.

As we have already seen, different colors differ in intensity, and the primary and secondary colors of the color wheel (see page 120) are more dominant than tertiary or other mixed colors. Among the pure primary colors,

red, orange and yellow are more intense than blue green and violet, so it makes sense to mirror the techniques used by painters and combine large, discreetly colored areas with one or more carefully chosen primary colored accents.

Such accents should only take up a small proportion of the frame if they are to be perceived as accents rather than dominant colored shapes. This type of composition requires a special kind of visual perception, rather like the need to 'see' differently when

you are searching for the framework for an image. Color photography requires you to take the additional step of analyzing the 'colorfulness' of the world around you.

Renowned color photographer Ernst Haas once said that he is actually a painter who just lacks the patience to paint, which is why he chose to compose his images using a camera. Successful photos are often structured using very similar rules and notions to those used in the composition of successful paintings.



A fanfare in yellow: The two pipes form a line that follows the Golden Ratio and the sky provides a second, more restrained colored accent. The remaining rather washed-out gray and brown tones make the colors seem more vibrant.

Here too, the obvious red accent contrasts really 'loudly' with the otherwise downbeat colors. The color is actually part of an illuminated hoarding in New York that only flashed completely red for a split second. I composed the image in advance and simply waited until the advert cycled to the right color.

Using Fewer Colors

Reduction to a minimum is an important aspect of many visual arts. At the turn of the 20th century, suprematist painter Kazimir Malevich had already painted a monochrome black canvas titled *Black Square on a White Ground*. At the time, this was seen as a purely provocative act, although Malevich was simply applying the tenets of the suprematist movement, which entailed a continual reduction in the variety of shapes and colors used to construct images.

'Reduced' images are often more powerful than ones that are filled with excessive detail,

and shooting in black and white was long considered the best way to make photographic images less complex and more artistic. Many of today's best-known photographic artists have switched to shooting in color, but they still use a pared-down range of colors and tones. Even the high-profile photographic artist Andreas Gursky uses a computer to adjust the colors in his images.

Generally speaking, color photography offers the viewer too many visual stimuli, and eliminating some of them is an important part of mastering the art of color photography.

Shooting in dim light – an approach successfully taken by Bernd and Hilla Becher – is one way to make your images less colorful. Shooting using backlight also effectively reduces the number and breadth of colors, but it does tend to make the sky look much brighter than the foreground, especially in landscapes. In such situations, using a graduated filter (one of my favorite tools) often helps to reduce contrast and darken the sky. Remember too, that shooting pictures of single-color objects is also an effective way to reduce the amount of color in an image.

Gray skies often provide ideal conditions for taking photos, especially at dusk when the light takes on a subtle blue tone. Blue is the only color in this image of a mountain peak on the island of La Palma. It contains just three tones: the black of the trees, the bluish gray of the mountain and the lighter blue/gray of the sky.



Using backlight is a great way to reduce the range of colors in an image and often produces a slightly mystical effect, as here, with the sun shining through the mist. This seaside home in Brittany looks almost like a fairy-tale castle. Here, the sun and its reflection form the vertical axis of symmetry and the horizon the horizontal axis. The promontory on the left and the waves on the right add variety to an otherwise rather static composition.

Balancing Shape and Color

The largely abstract combination of shapes and colors that makes up an image should itself be capable of attracting a viewer's interest, regardless of the actual subject. A great way to get a better impression of the basic form of an image is to rotate it through 180 degrees. This will help you to see the basic composition separately from the objects portrayed.

The painter Georg Baselitz paints many of his subjects upside down to emphasize the

importance of the brush strokes rather than the objects they depict. A good photo should still have a pleasing effect when turned on its head.

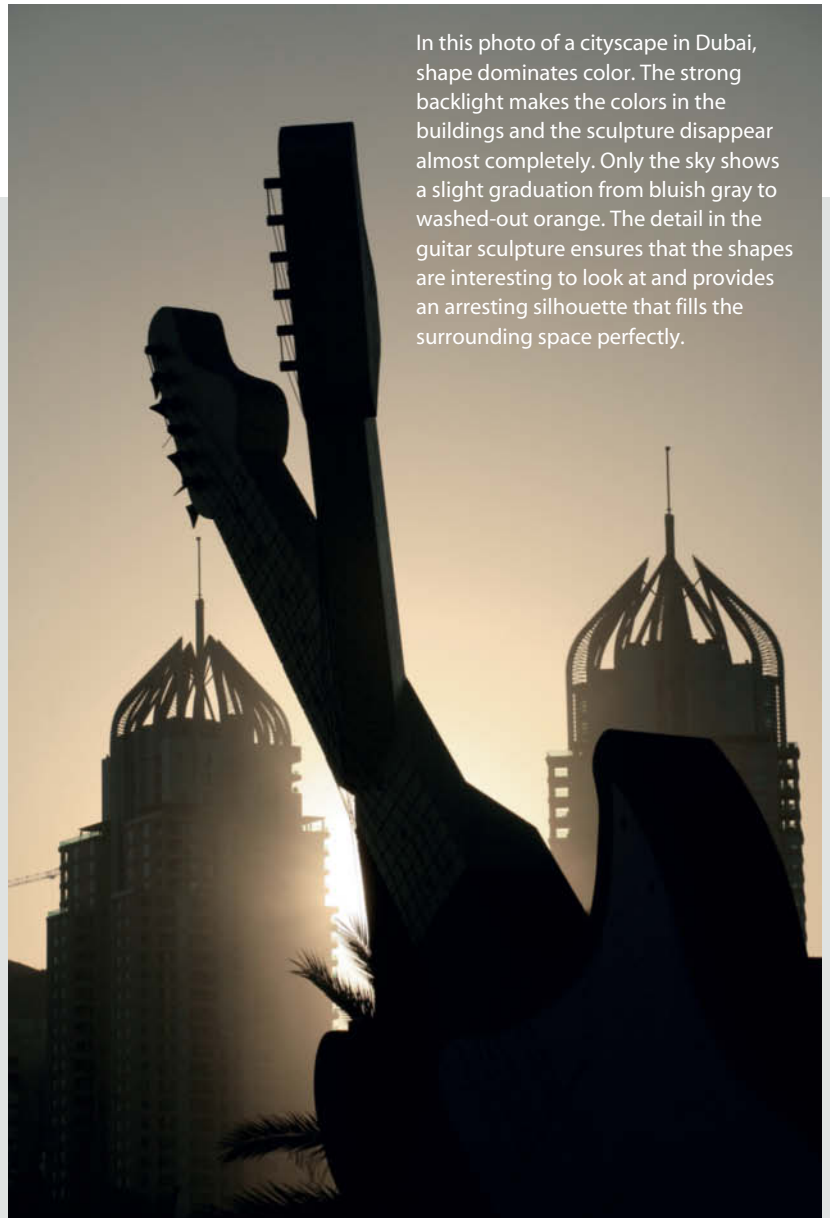
Fine color photos contain a balanced combination of shapes and colors put together in much the same way as a painting. Shape and color can relate to each other in a number of different ways, the most common of which are:

1. Shape dominates color.
2. Shape and color are perfectly balanced.
3. Color dominates shape.

I strongly recommend that you take the time to practice shooting images of all three types. This way, you will discover for yourself which situations suit a monochrome approach and which would look better in color.



Above: In the top photo, color dominates and the shapes of the reflected lampshades take on a secondary role. The primary yellow tone and larger size of the center lamp also dominate the secondary orange of the two smaller shades. The lower image shows two similarly shaped oriental arches. The light color framed by the arch in the fence in the foreground contrasts with the darkness of the shadowed arch in the wall in the background, providing a balanced juxtaposition of shape and color.



In this photo of a cityscape in Dubai, shape dominates color. The strong backlight makes the colors in the buildings and the sculpture disappear almost completely. Only the sky shows a slight graduation from bluish gray to washed-out orange. The detail in the guitar sculpture ensures that the shapes are interesting to look at and provides an arresting silhouette that fills the surrounding space perfectly.

Using Filters

The filters used most commonly in digital photography are UV, skylight, polarizing and, most importantly, graduated filters.

UV and skylight filters have very little effect on the amount of light entering the lens and are often used primarily to prevent lens damage in everyday use. However, any filter is an additional optical element that has the potential to reduce the quality of the resulting image, so it is important to use the best filters you can afford and to keep them as clean as possible at all times.

A **UV filter** cuts out the ultraviolet light that often causes a lack of sharpness in distant details in landscape images.

A **skylight filter** has a virtually undetectable pink tone that takes the color

temperature of the image down a notch, providing pleasant warm tones, especially under blue sky and in the midday sun.

Filters that provide greater changes in color temperature are not generally used in a digital photography context, as the digital imaging process provides the option of altering white balance either in the camera or later during image processing. When shooting digitally, polarizing and graduated filters are the ones I reach for most often.

Graduated filters are ideal for reducing the contrast between the sky and the other details in landscape images, especially in backlit situations.

I usually use a two-stop neutral gray graduated filter. Any details – skyscrapers or

trees, for example – that are unintentionally darkened along with the sky can be lightened to match the rest of the image at the post-processing stage.

Used correctly, a graduated filter does nothing more than bring out the existing detail in a backlit sky.

Polarizing filters are often used to reduce reflections from non-metallic objects and to increase the contrast between clouds and sky by reducing the amount of non-polarized light that enters the lens.



Above : In the photo on the right, a polarizing filter was used to make the reflections in the windows less obvious and increase the contrast in the sky

Left: A graduated filter helped preserve detail in the clouds above this disused mine and prevented the highlights in the sky from burning out

Abstract Photography

Photography almost completely replaced the visual language established by the naturalistic style of painting favored in the 18th and 19th centuries. From the advent of impressionism onward, painting diverged from the naturalistic style and established itself as a completely independent – and often abstract – way of viewing the world, while photography became responsible for portraying the world realistically.

In due course, photography, too, began to escape from that constraint and developed

further to embrace the notion of abstraction. Early examples of this approach were the work of Alexander Rodchenko at the turn of the 20th century and the famous 'photograms' created by László Moholy-Nagy in the 1920s.

Nowadays, the broad photographic genre includes all imaginable forms of abstraction.

But what does 'abstraction' actually mean? The dictionary defines it as 'elimination of the concrete'. In other words, abstract thoughts

separate themselves from the world of everyday objects and begin to take on a life of their own – and the same is true for images and imaging processes.

Just as painting is an abstraction by definition, photography necessarily reproduces objective reality. Nevertheless, abstract photography signifies a movement away from a purely representational way of thinking. In other words, as soon as the abstract patterns in an image become its actual content, photography is no longer

This simple shot of a white wall photographed looking upward toward the blue sky over Lanzarote has its own distinctive visual language that is worlds away from traditional postcard-style clichés. Composed entirely of white, gray and blue angular forms, it is not even entirely clear which of the shapes embodies the positive and which the negative aspect of the image, and our brain perceives the blue of the sky as closer than the white wall.



The textures that have etched themselves into this old door over the years make fine abstract art. Not even Kurt Schwitters, master of the abstract 'decollage' form, could have painted a better picture. Part of the aim of this image was to retain a hint of connection with everyday reality. The composition is strongly oriented around the rules of the golden ratio and the clear structure of the individual elements contrasts beautifully with the manifold organic forms contained within the frame.

concerned with reproducing reality. The dilemma here lies in the fact that every subject that we capture photographically has an abstract structure as its basis.

Most people are used to concentrating on the content of an image, even if its effectiveness depends on the strength of its underlying structure.

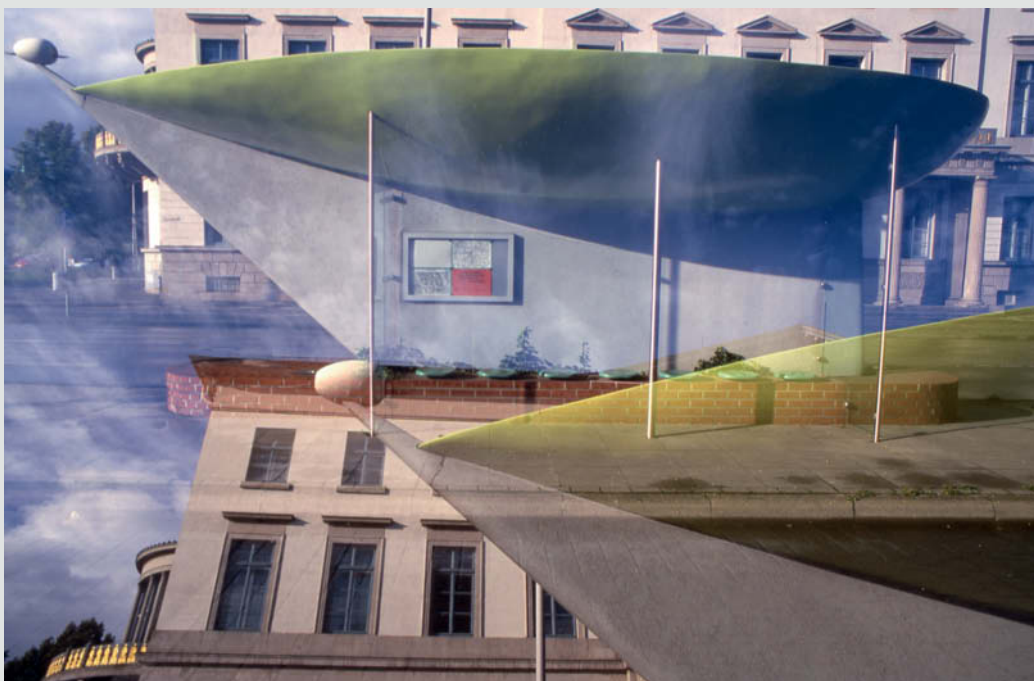
As we have already seen, you can check just how effective this structure is by rotating an image by 180 degrees to loosen its grip on 'reality'.

The abstract structure of an image comprises all the lines, shapes, patterns, textures and colors it contains. The painter Vassily Kandinsky, who was a master of abstract image composition, developed an entire philosophy surrounding the way shapes and colors relate to each other. Kandinsky saw these deliberate juxtapositions as a creative act.

The art of truly great photography lies in the ability to see and interpret the abstract patterns that underpin reality and to frame

each image so that these patterns form a compelling structure for the image itself. The subject can either dominate or form a balance with the underlying shapes. Alternatively, as shown in the images on these pages, form can take priority over content.

Macro situations provide many opportunities to capture wonderful abstract images. In the image on the left, the curves in the two fibers form a lovely contrast with the edge of the palm leaf, which follows the vertical golden ratio dividing line. The right-hand image shows a complex shape and its shadow, made abstract by separating the details from the surroundings.



In the photo on the left, a double exposure of an unusual bus shelter and the sky from an architectural shot has produced an image that has a very cubist feel to it. The analytically minded cubist painters deconstructed their subjects and painted them viewed from multiple angles in a single image.

Avoiding Clichés

Many hobby photographers are satisfied if they end up with pictures of a sunset, their kids or some nice, colorful flowers. However, the more time we spend experimenting with the photographic medium, the less satisfactory such everyday images become. One reason for this could be that sunsets are simply such awesome events that a photo of one can only ever be a poor imitation.

Sunsets, flowers and similar subjects often look 'cheap' or bland when captured in photos. A department store postcard might be technically well shot, but lacks depth when compared with a landscape by Rembrandt or van Ruisdael. Many photos simply lack 'that certain something' – not in the sense of a cheap punchline, but rather on an emotional level that provokes deeper feelings than a simple "Oh, that's nice".

The French philosopher Roland Barthes described 'that certain something' using the notion of 'punctum', which describes images that 'pierce' the viewer with their beauty. This difference between bland and beautiful could perhaps be expressed by the difference between a person whose natural, inner beauty shines through and one who attempts to embody the latest 'look' with the help of make-up or cosmetic surgery.



How dull can a photo of an extremely pretty object be? The photo of a hibiscus bloom above is a good example, whereas the image on the right, with an unusually shaped subject and shadows in the background, is not so trite.

Abstraction is a great way to keep photos of plants and flowers interesting, and can be achieved either by heavy cropping or by using deliberate defocusing effects.



Many photos of sunrises and sunsets bear witness to the photographer's lack of empathy with the subject, and provide a simple reproduction of a scene that is generally considered to be aesthetically pleasing.

However, it is also possible to photograph 'beauty' in different and interesting ways. The photographer Karl Blossfeldt is a great example of an artist who

has developed a unique visual language in his photos of plants and flowers. His monochrome images are more reminiscent of architectural and ornamental imaging than of conventional floral photos, and are anything but bland.

Of course, we all love the idea of idyll, but could it be that 'idyll' is a concept based on false claims? If you look carefully, every 'paradise' has its weak spots, just as successful

people have their weaknesses too. A great photo can be compared with a novel that reveals its characters' imperfections, while an everyday snapshot is more like a cheap, dime-store novella with superficial protagonists and a clichéd story.



Left: A sunset of the kind photographed millions of times every day. The fact that photos of sunsets are a dime a dozen helps to make every such image appear hackneyed to all but the least experienced viewer.

Capturing the feel of a sunset without actually portraying the sun: The bamboo leaves in this image look like part of an oriental ink drawing. The individual leaves embody a wealth of shapes, from thin to full-bodied, overlapped and forked. The smaller leaf between the two on the left provides an extra detail that attracts the viewer's eye.



Bringing Order to Chaos

While color photography obviously involves ordering colors within the the frame, we cannot afford to neglect ordering shapes too.

Producing ordered images is most difficult in the context of street

photography, represented here by the ultimate challenge – the hubbub of a large city in India. In this case, the architecture and its inhabitants provide a chaotic, unordered scene. The streets are overflowing with

pedestrians, bicycles, cars, rickshaws, animals and carts. It often feels impossible to produce balanced-looking images of this type of scene, especially when using a wide-angle lens.



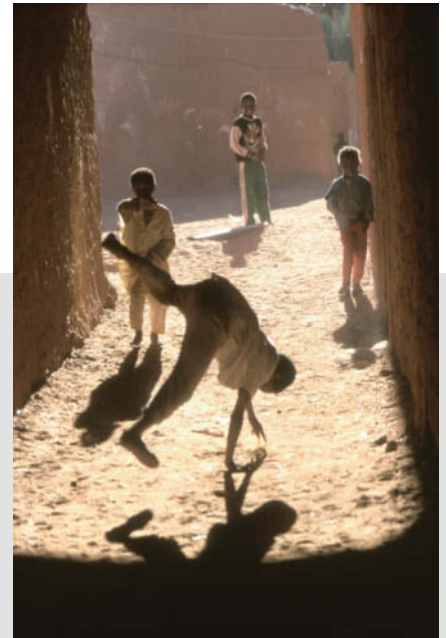
The structure in the image on the left is underpinned by the emphasis on the central vertical axis of symmetry (see the sketch above). The central pillar in the rickshaw's chassis continues the line formed by the telegraph pole, bringing order to the otherwise random-looking mass of cables, buildings and vehicles.

In the image on the right, the rickshaw driver and his passenger are effectively embedded in the frame, but the surroundings are simply too chaotic. The driver is not distinct from the background and detail in the people and buildings behind him adds to the confusion. The pole in the background also appears to be 'growing' directly out of his shoulder.



Another way to 'calm' the chaos of a busy city scene is to mount your camera on a tripod and use a neutral density filter to lengthen the exposure time. This approach

allows you to 'melt' some of the distracting chaos into movement blur and gives an image extra vigor.



Below: Varanasi, India. The two boys in the center stood stock still for the entire three-second exposure while one of the country's countless sacred cows passed by in a wonderful whirl of blur.

In contrast, the boy doing a cartwheel in the image on the right (shot in Timimoun, Algeria) was captured using an exposure time of 1/250s to 'freeze' the action. The triangle formed by the three boys in the background and the vertical line formed by the subject's arm and its shadow provide the basic structure of the image.



Photographing People

Many people feel a successful portrait should show young, smiling faces in well-lit surroundings. However, such images often appear superficial, and you need to concentrate on more than just good lighting to capture effective portraits. Every individual has their own character and spiritual views, as well as a relationship with their immediate surroundings, which have played a key role in shaping their lives.

An effective portrait should reveal the subject's character and include any gestures and physical characteristics that help to emphasize the context. For the photographer, this means capturing a moment that contains all these aspects of the subject's character. A quick smile is usually not sufficient to reveal anything meaningful about what is going on inside a person, which is probably why there are so

few portraits of smiling people to be found in the archives.

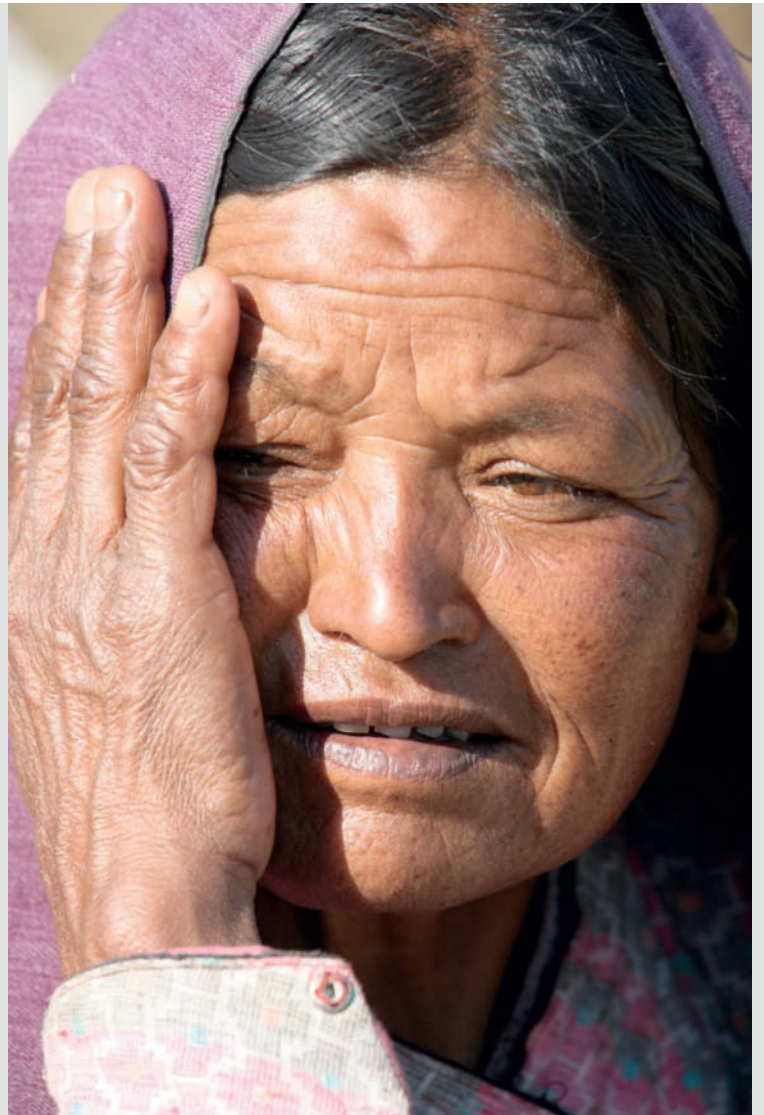
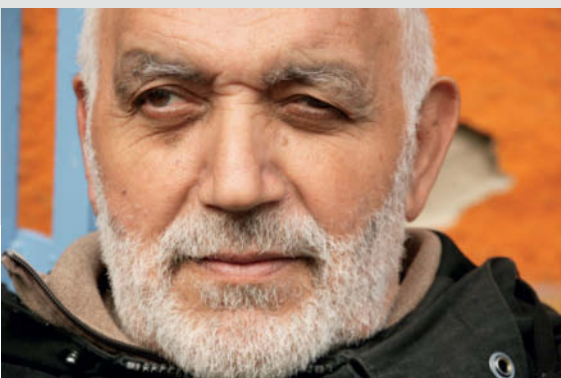
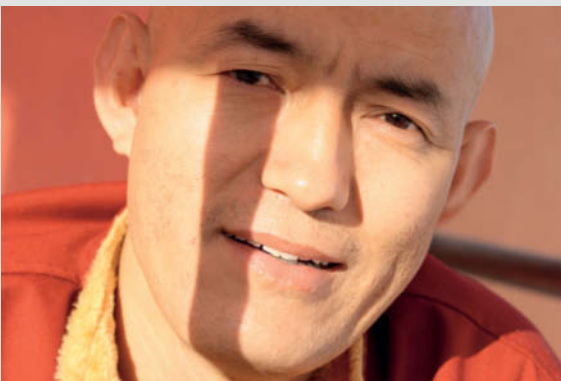
'Serious' portraits can be captured both from a distance and as part of a personal dialog with the subject. It is always more difficult to photograph people you don't know, and it is tempting to use a telephoto lens to capture pictures of strangers from a distance. However, you will always achieve better results if you approach your subjects

These three images were all captured during conversations with their subjects.

While the young monk was explaining his Buddhist faith to me over coffee, the shadow on his face provided an interesting accent that successfully interacts with the dark portion of the chair back on the right.

The lower image is of a Jordanian antique dealer in the Kreuzberg, Berlin. The bright colors in the background provided added punch and the tight crop that covers the subject's forehead gives the landscape-format image a slightly unusual look.

The image on the right shows a Nepalese laborer whose face and hands bear witness to a life of hard work. Here too, the color in the headscarf enriches the visual harmony within the frame.



and involve them in the image capture process and engage them in conversation. If you manage to ask a personal question or two, your subject is much more likely to reveal more of their inner self. Only take out your camera and begin to shoot once you have engaged your subject.

On a technical note, a 100mm (or equivalent) lens is still the best choice for shooting portraits because it allows you to fill

the frame with your subject's face without having to get too close. You can, of course, shoot from greater distances using a longer lens and, as Cartier-Bresson once said, concentrate for just long enough to "level the camera and trap the fleeting prey in your little box".

It takes courage to point a camera at strangers and you need to be able to get to the nub of the situation quickly if you are to

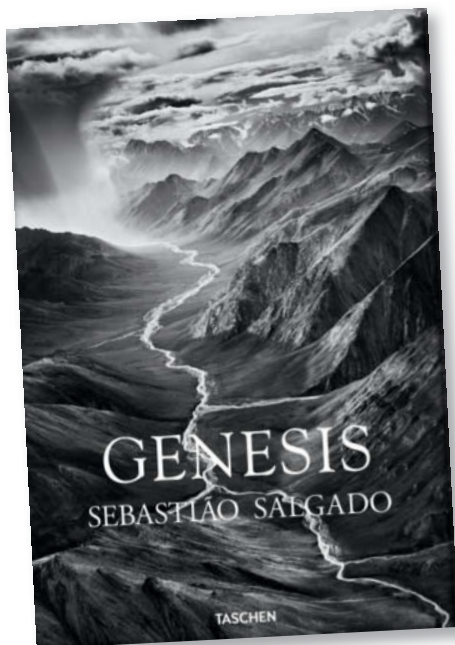
capture the right moment without annoying the subject. If you are 'discovered' when shooting from a distance, always approach the subject, show them the image and ask for permission to keep it. If the person concerned doesn't wish to be photographed, you should delete the shot immediately. (keh) **ct**

This photo of a little girl in a slum in the Nepalese capital, Kathmandu, is loaded with emotion for me. I was amazed to find that no-one here begged and everyone I met was friendly to me. The entire situation moved me deeply.

The young man in the portrait below is a Canadian film-maker and fashion designer who I photographed in Berlin. I took this photo from below to emphasize his charisma and strong personality.



Book Reviews



Genesis

Sebastião Salgado
Published by Taschen, Cologne
520 pages
10 × 15 inches, hardback with 17
fold-outs and a printed dust jacket
US\$49.99
ISBN 978-3-8365-3872-5

Genesis

Fragile Beauty

In his previous work, Salgado always critiqued the here and now. The photos of refugees on the move and migrant miners in his highly acclaimed books *Migrations* and *Workers* were a means of expressing his disapproval at the way things are.

This latest book of photos, *Genesis*, enters new territory. Motivated by the success of his reforestation work in Brazil, Salgado wanted to get to grips with how mankind and nature can coexist. The photos tell the story of his 'time travel' back to where life began and his search for answers from indigenous peoples whose lifestyles are still largely beyond the reach of modern society.

The five chapters chart Salgado's travels to far-flung corners of the earth, depicting more than 30 places that he visited during the eight-year project. Most of the photos are black and white and many are also strikingly grainy, conveying a raw charm that effectively complements the awe-inspiring impact of nature.

This approach works particularly well for his forays into cold, mountainous regions dominated by snow and rock. Rich in contrast, these areas are perfectly suited to the means he has chosen to portray them. But some of the other subjects, particularly a pair of parrots in a primeval forest, cry out for color, despite the

fact that Salgado crafts his photos along artistic rather than documentary lines. Stark contrast is one of the primary features of these works and gives some of the landscapes a hyper-real, three-dimensional feel.

It is easy to criticize the obvious fact that many of the photos of people in the book are staged, but Salgado does not see himself as a documentary photographer but rather as an artist fashioning a tribute to Planet Earth. In fact, the portraits are a large part of what makes this such an entrancing book. Most of us have seen countless nature photos of Africa and other places in all sorts of styles, but Salgado's portraits – which allow us into the lives of indigenous people and their relationship with the natural world – touch us on another level and make us pause to reflect.

At the cover price, we can definitely recommend *Genesis* as excellent value, worth purchasing even unseen. With 520 large-format pages and weighing almost four kilos, it is certainly a heavyweight volume. For black-and-white photography buffs, the book offers dozens of beautiful photos that take us to the uttermost parts of the earth and face us with some of the destruction already wrought by the human race and its terrible lack of restraint. (tho)

Many of Salgado's photos of people seem 'staged' but this does not make them any less captivating



Image: Sebastião Salgado/Amazônicas images

The Search for Detail

Urban Elements

The importance and greatness of photo books are often measured using abstract values such as 'artistic depth' or 'relevance to the contemporary scene'. Anyone taking a first look at *Urban Elements* will probably end up using more mundane criteria: it weighs in at nearly eight pounds, is more than two feet wide when laid out flat and takes up the viewer's entire field of vision when viewed at a normal distance. This book makes a serious physical impression before you even begin to consider its contents.

A look inside quickly reveals that the book's sheer size is not an end in itself. David Koenig's photos show details of mostly modern urban architecture, and each image is an individual study captured with striking precision and without any surrounding detail to betray the actual location. Only locals or those in the know will recognize the buildings, although the comprehensive index reveals all to the curious reader.

The interchangeable nature of modern cities is not a new subject and has been documented extensively over the years. What makes

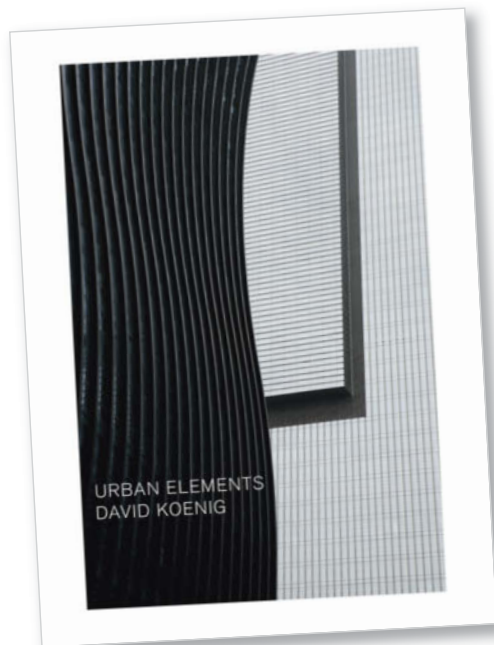
this particular book so compelling is the photographer's skilled use of the elements of aesthetic perception.

Koenig applies great expertise in his choice of angles of view and his framing. His use of shape and color inescapably draws the reader into his images without any need for further reflection on their actual content. Once you have fallen prey to this spell, you can set off on your own search for your personal favorite among these visual pearls.

Koenig's uncompromisingly minimalist compositions provide valuable insights that will help many photographers to improve their technique.

A third, more speculative level of discovery involves the question of whether the similarity between many of the elements of modern global architecture reveals something about a culturally-based sense of aesthetics that forms a bond between humans everywhere. While it doesn't deliver specific answers, *Urban Elements* raises many intriguing questions.

(Robert Seetzen/tho)



Urban Elements

David Koenig
Published by Prosperous Printing
235 pages, 137 color photos
Text in English and German
16.8 × 13.7 inches
US\$50
ISBN 978-3-8640-7115-7

Koenig isolates distinctive architectural features from their surroundings and presents them in a remarkable new light

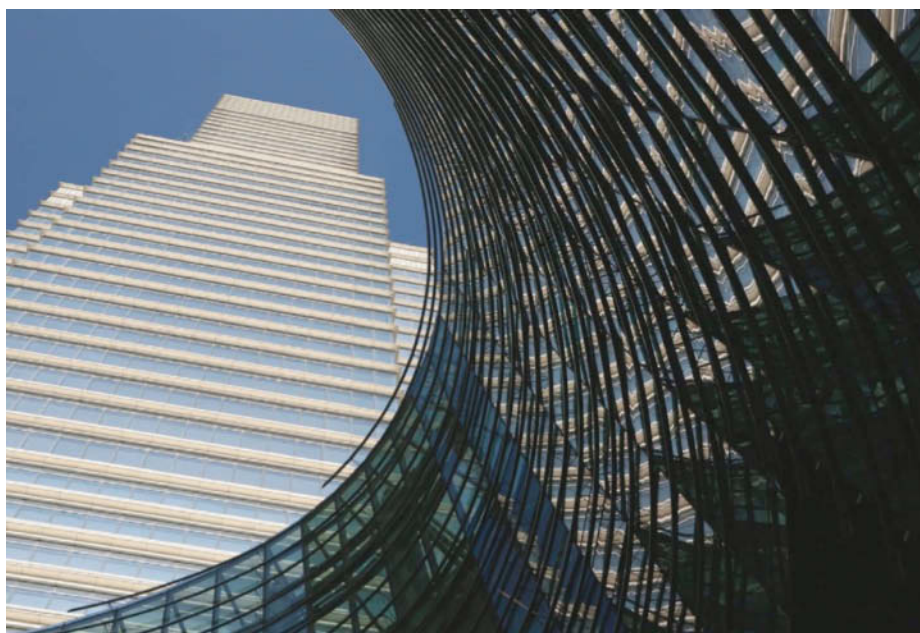


Image: David Koenig, 2012, Frechmann Köln

Coming up in Issue 15



Low Light Photography

Our latest in-depth workshop gives you plenty of technical tips as well as helping you to find the right subject for your own nighttime experiments. As well as working with conventional cameras, we also check out a bunch of iOS and Android apps designed to keep you shooting when the light gets low.

Similarity Searching

If you are on the lookout for duplicate images or you need a photo that is similar to one you already have, you need a tool that supports similarity searching. Visual search tools also help in the fight against copyright infringement. We take a look at the latest search tools and test what they are really capable of.



GPS for Photographers

Increasing numbers of cameras have either built-in GPS modules or support for accessory units. Geodata gives photos an extra digital dimension and we explain how geotagging works. We also introduce the hard- and software you need to tag your own photos and show you how to work around some common tagging pitfalls.

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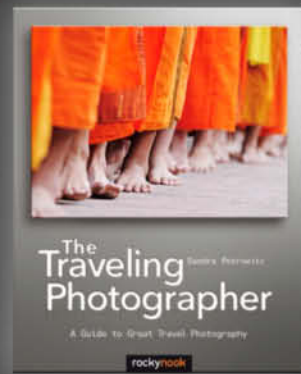
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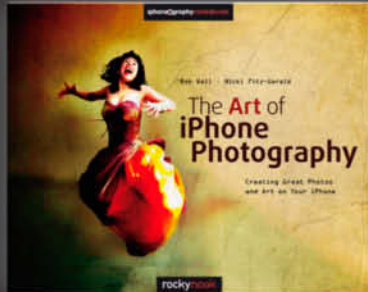
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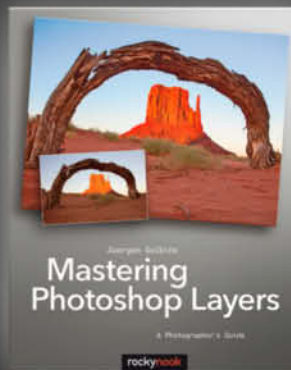
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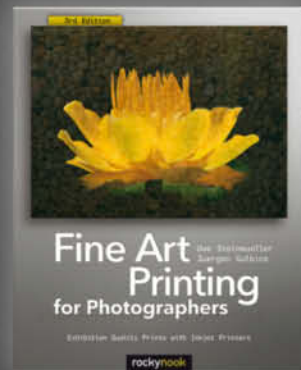
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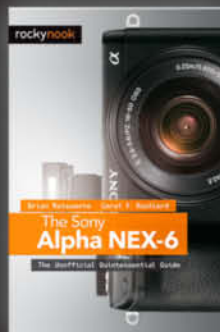
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