

DIGITAL PHOTOGRAPHY 101

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To: SMCCC

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INTRODUCTION

- What can we do to make better pictures?
 1. Get it right in the camera
 2. Simplify the subject

- Remember its not just about the light..... Its all about the light
 1. What light is important?
 2. How can we control the light in our pictures?

“ If it doesn't look good going into the camera, it won't look good coming out of the printer”
Loosely quoted from Vincent Versace

SO WHAT CAN WE CONTROL

- Identify the subject
 - Composition / Zoom
 - Fill the frame with the subject
 - Can you zoom in with a 50mm lens?
 - Adjust our DoF accordingly, Bokeh/f64 landscape
 - What is / or more importantly, what needs to be in focus? How sharp?
 - Control the light / exposure
 - What's the dynamic range of the light?
 - Where is the light coming from? Is it hard or soft?
 - What's most important: Shutter speed, f-stop, ISO?
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INITIAL THOUGHTS

- Digital Photography is just starting to open unlimited potential for anyone wanting to better express themselves through photographs.
 - The ability to share pictures in real time around the world with friends/family or report breaking news....
 - The image quality from our iPhones is starting to rival what a \$1000 film camera a generation ago could produce.
 - Digital IQ is now better than 2 ¼ x 2 ¼ film.
 - The cost of a bit is much less than film. (I shot 1853 images in one day last January and I've shot over 10,500 since January 1)
 - Post processing, video, HDR,

And the most important break through of them all:

TONIGHT'S APPROACH

- There are MANY different types/genres of photography:
 - Fine Art, Photojournalistic
 - Snapshot/Candid, Portrait
 - Studio, Commercial.....
- What we are going to talk about tonight can be used in any of these categories. We'll discuss in detail many of the building blocks available in most cameras and how those tools work together (or against each other).

“Great pictures are made not taken” *Ansel Adams*

BASIC CAMERA ADJUSTMENTS

- Things we can adjust
 - Composition – (Another day's discussion)
 - Focus – Lenses, Field of View, Depth of Field
 - Exposure – ISO, f-stop, shutter speed
 - Film / Sensors specific sensitivities
- Things here haven't changed since the early days of photography. What has changed is how we make those adjustments

SOME DEFINITIONS:

- **Focus:** An image, image point or region, is ***in focus*** if light from the subject is converged as much as possible in the image, and is ***out of focus*** if the light is not well converged. The border between these is sometimes defined using a circle of confusion criterion.
- **Angle of view** describes the angular extent of a given scene that is imaged by a camera. It is used interchangeably with the more general term field of view (FoV).
- **Depth of Field:** (DoF) is the distance between the nearest and farthest objects in a scene that appear acceptably sharp in an image. **The DOF is determined by the camera-to-subject distance, the lens focal length, f-stop,** and the format-size or circle of confusion criterion.

LENSES

WIDE ANGLE, NORMAL, TELEPHOTO

- A **Normal** lens is defined technically by the Angle of View (approx 60 deg), which is a function of the diagonal of the sensor/film and the lens' focal length, in a 35mm camera a 50mm lens is considered "normal".
- Similarly "Wide Angle" refers to lenses that are shorter than 35mm and "Telephoto" as anything greater than 85mm.
- With digital cameras and in particular DSLRs we also talk about a crop factor because the sensor diagonal is frequently smaller than normal 35mm film.
- With significantly different size cameras a 35mm equivalent is frequently talked about.

FOCAL LENGTH VS. DOF

- DoF is controlled by lens focal length, distance to subject, f-stop, and sensor size.
- Since the sensor size is fixed: the only tools we really have to control DoF are the focal length of the lens, the distance to the subject, and the f-stop.
 - OBTW if we fill the sensor with the subject by moving closer/farther away after changing the lens, the only effective tool for controlling the DoF is the f-stop.
- Relative separation between subject and background can be used as well for improved bokeh, etc.

AUTO FOCUS,

- Basically there are three or four major focusing modes in most cameras:
 - Manual – self evident
 - **Single Shot – press the button half way down and the lens focuses and remains at that distance until the picture is taken or the shutter is released**
 - Continuous Focus – press the button half way down and the lens focuses and then attempts to “track” the subject and keep it in focus
 - Live Focus – viewing actual sensor image data
 - There are some significant advanced schemes designed to improve auto focus modes (facial recognition..)
 - What in the subject doing relative to the camera?
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AF-THINGS TO WATCH OUT FOR

- Many AF sensors have two different types of focus points, normal and cross-type, and they don't always work the same, Cross-type work a horizontal as well as a vertical polarization, normal points work in a single direction.
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- Result: AF points work REALLY well on vertical lines
- Some of the new modes can be very effective particularly for moving objects

DYNAMIC RANGE

- Dynamic range is the difference in the amount of light between the brightest point in the field of view and the darkest.
- It is frequently described in terms of stops (a doubling / halving the light)

EXPOSURE

- Only three things can be changed
 - ISO or (ASA for some of us old fogies)
 - F-stop
 - Shutter speed
- Light meters are designed to measure the existing light so an appropriate set of exposure settings can be used

EXPOSURE is a **trade** between these factors. Understanding these trades allows you to get the “Best Possible” picture.

ISO

- The ISO number reflects the sensitivity of the film or sensor to light, obviously with film to change ISO you must change the film, with digital capture you can turn up the gain of the sensor.
 - Commercial grade films were usually available between ISO 20 and 400 with a couple specialty outliers
 - Digital sensors are now advertising usable ISOs from 50 to ~24,800 with the ability to push upwards of 100,000
 - And the down side is: Grain and/or Noise, as you increase the ISO the grain size increases and/or the noise level increases. You also lose dynamic range.
 - Ansel Adams Zone System was based on 9-10 stops of usable light for both capture and print, current high end sensors are displaying > 22 stops.
- ISO sensitivity is linear therefore to adjust up/down one stop the ISO has to be doubled or halved. (eg 100 to 200)

NOISE / GRAIN

- Two types of noise “Chromatic” and “Luminance”
 - Chromatic noise tends to be more obvious in dark areas and in the red/blue channels.
 - Post processing images to “pull” details out of dark areas up is a common location to see noise.
 - Noise reduction technology has come a long way, however, in most cases it involves blurring of some of the data, what, where, and how much, you should be aware of.
 - 3rd-4th gen sensors have made significant improvements.
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F-STOP

- The f-stop is a representation of the effective aperture. It is measured relative to the focal length of the lens.
 - Therefore an f/4 on a 16mm lens (~4mm) allows in the same amount of light as an f/4 on a 400mm (~100mm)
- Adjustments to f-stop are an inverse function, a smaller f-stop means larger opening, and more light. F-stops are typically measured in 1-stop increments. f/2.8, f/4, f/5.8, f/8, f/11, f/16..... **Each stop represents a reduction of half the light !** (most cameras will allow 1/3 – 1/2 stop adjustments)
- An decrease of one stop of aperture requires either a doubling of the exposure time or doubling of the ISO, and/or some equivalent combination of the two to keep the same exposure.

F-STOP AND DOF

- For any given lens the only effective “in camera tool” to adjust the depth of field is the f-stop.
 - The smaller the aperture the greater the depth of field
- There are other solutions, but they are beyond today’s scope

F-STOP AND DOF CONTINUED

- Increasing the aperture (eg changing the f-stop from f/8 to f/4, (1 stop)) reduces the effective DoF and is a frequently used tool to isolate the subject from the background.

105mm
1/60s f/3.3
Iso100 EV -0.33

F-STOP AND DIFFRACTION

- Diffraction, is a distortion of the light resulting from the interaction of the wavelength of the light, the aperture of the lens, and the sensor resolution.
- As the aperture gets smaller the effects of diffraction become more visible. Most newer DSLR / lens combinations have a limit of about $f/8$ - $f/11$ before diffraction starts to become an issue.
- There is no free lunch here.

SHUTTER SPEED

- The other control we have to effect exposure is shutter speed. Shutter speed is linear so to reduce the light by one stop the shutter speed needs to be reduced by a half. (eg 1/100s to 1/200ths)
- Shutter speed can be used to either stop motion or to allow for desired blurring to occur.
 - There are a lot of recipes out there for the right shutter speed, **all dependent on the distance to the subject and how fast it's moving.**
- Shutter speed is also important to consider when hand holding a shot.
 - Historical gouge for hand holding a camera is 1/focal length (ie for a 50mm lens, 1/50th of a second) **see note above.**
 - Good shooting technique can make a huge difference (OBTW so can tripods)
 - VR/IS systems are designed to improve this, some claiming up to 4 stops, age tends to be a counter factor ;o)

PANNING

- Panning can also be an effective tool for keeping things in focus when the light is low or when the effect is desired.
- There are some great subjects for practicing panning: seagulls, cars, speedboats...
 - It is a skill that needs to be practiced and polished.

110mm
1/20s f/10
Iso100

LIGHT METERS

- Light Meters / Exposure meters measure the light (incident or reflected) at a sensor and display a recommended exposure value.
- There are multiple different types and modes
 - In camera: spot, center weighted, 3D matrix, etc.
 - Off camera: spot, reflected, incident.
 - Flash: incident
- Each type has a design use that it is optimized for and will frequently work in other situations.
 - Master one of the more generic meters and then focus on specialty meters
 - Camera manufacturers have a vested interest in getting their “general purpose” meter right, so for most uses it should produce excellent results.

Use your camera’s “Blinkies” and multichannel histogram

HISTOGRAMS

- “Shoot to the Right”
 - Don’t overexpose any channel
 - Easier to reduce brightness than recover it in post.
- Multi-channel histogram
 - Watch the **RED** channel

WHAT IF THE METER IS WRONG?

- Never happens right? WRONG
 - Exposure meters will give you a great value if the scene is all medium gray, and will try to average or adjust for brighter and darker areas.
- But if the average value for the scene is very bright or very dark (black background) the exposure will be off.
- One tool for adjusting for this difference is the EV compensation button
 - I highly recommend you find this button and figure out how to adjust it.
 - DON'T FORGET TO CHANGE IT BACK ;O)
- Another approach is to bracket the shot.

OVER/UNDER EXPOSURE

- What happens when the lighting or your subject isn't average?
- Probably your most important tool in this environment is the histogram and the LCD
- Several good options in this environment
 - EV button works well (my normal goto solution)
 - Use manual exposure settings
 - Set up a bracketing scheme,
- OBTW if you're shooting RAW you have a +/- 2 stop correction in post if you don't overexpose a channel.

THE BALANCING ACT

- All images are a trade of the above factors from an exposure, DoF, FoV perspective.
- Frequently the lighting is not perfect for the shot desired, and you have to decide which factors are the most important:

D200 - 400mm
1/80s f/5.6 Iso800

THE AUTO MODES

- The preceding discussion is as true for film as it is for digital. Ansel Adams made the same type of trades on an 8x10 film camera as we make in a APS-C point and shoot. The big difference is we now frequently let the camera do the heavy work.
- Auto-exposure / “Easy” auto modes / Scene modes... balance the exposure/auto-focus options to “optimize” the picture based on some predetermined algorithm.
- There is no mode that can’t be replicated manually but why? (OBTW in some cases there are good reasons)

P S A M: THE BIG THREE

- Manual, self evident, but can be very flexible and is good to master so you understand what's going on.
- S: Shutter priority-photographer sets the shutter speed and the camera tries to adjust the aperture to balance the exposure.
- A: Aperture priority-photographer sets the aperture and the camera adjusts the shutter speed accordingly.
- P: Program Auto; the camera automatically adjusts shutter speed and aperture according to a built in program to “ensure optimal exposure in most situations” (Often called the “Professional” mode)

D300 PROGRAM MODE SCHEDULE

Bottomline; It will get you a good exposure in most situations

A COUPLE COOLPIX EASY MODES:

- Close Up: (autofocus to continuous, P exposure, motion detection on)
 - Landscape: (focus to infinity, P exposure, motion detection off)
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THE DIGITAL DIFFERENCE

- Other than the instant gratification and ability to check a picture in the field ;o))
 - Goods
 - Can change sensitivity settings between every shot.
 - ISO improvements
 - You can recover many faults in post-processing with little to no impact
 - Others
 - You can do all the above so....
 - Ooops.. OBTW we haven't really talked about the interpretation issues.
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DIGITAL CAPTURE VS FILM CAPTURE

- With film we have three stacked layers so that as light hits the film at a given point the exact color is recorded at that point.
- With digital we have a bayered sensor with different colored filters at each pixel and then our software interpolates the other colors for each pixel
- This can result in a softer image
- On top of that we usually have an anti-aliasing filter, which will produce a softer image.

Image from:

http://en.wikipedia.org/wiki/File:Bayer_pattern_on_sensor.svg

INTERPOLATION ISSUES

- With film you intentionally or otherwise decided a lot about color/light sensitivity when you bought your film.
- Since sensors are digital data the interpretation of those numbers into “real” color means you can/must decide about the interpretation of that data (either at capture for JPG generation or at RAW conversion). You can decode the numbers to look like Velvia, Kodachrome, or even Pan-X black and white depending on your settings.
- If you shoot JPGs those settings must be selected in the camera.

OPTIONS (BASIC)

- Basic Adjustable parameters:
 - Brightness
 - Contrast
 - Saturation
 - Sharpness
 - Hue
 - White Balance (does a white piece of paper look white?)
 - Colorspace (better left for a more indepth discusison)
- Combinations can be created by individually adjusting paparameters and then saved as a new preset. Presets can then be used for in camera and/or in computer processing of RAW data.

OPTIONS (“ADVANCED”)

- More Advanced Adjustable parameters:
 - Active D-light (may be a Nikon term, certain Canon has a similar concept)
 - Auto ISO
 - Long exposure noise correction
 - Image Dust Off
 - Focus Tuning
 - Red Eye Reduction
 - Noise Reduction
 - Lateral Chromatic Aberrations LCA
 - Lens Corrections (known distortion factors)
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JPG VS RAW

- ALL images are collected on the sensor as RAW images.
- Those images are worthless until they are processed somewhere! Sooo.... where do we want to process the RAW to useful image? If we process them in camera typically the color data is compressed into 8bit color channels using the presets we have set in the camera.
- We can process the image in a computer with the same presets and get EXACTLY the same image,
- Or we can change some of the factors and get an image with a different color depth, color space, sharpening....

BJ'S CAMERA SETTINGS

- **Wildlife:** Autofocus continuous, aperture priority usually wide open to get best shutter speed available, ISO adjusted if more speed is needed
- **Landscape:** Autofocus Single, aperture priority f/11 to f/16, ISO as low as possible
 - Panoramas: Manual everything
- **Orchids:** Manual focus, manual exposure or aperture priority with flash, ISO as low as possible
 - **Image Stacking:** Manual focus, manual exposure, Flash iTTL

Get it right in the camera

REMEMBER:

- For anything other than photojournalistic work what we as photographers are trying to capture and express is our feeling, what we were seeing, when the photo was taken / processed, and to share that emotion with our viewers.

BACKUPS