MACRO PHOTOGRAPHY

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Outline

- I. Define terms. Focal Distance, Node, Image Size
- 2. Review focusing and DOF
- 3. Discuss sensor size and cropping
- 4. Techniques
- 5. Show equipment
- 6. Show sample scales
- 7. Show sample images
- 8. Good news and bad news

TERMS

- Focal Length of Lens: Distance between lens node and sensor when focused at infinity.
- Lens Node: Plane within lens where rays cross. Typically at the diaphragm. Rarely in the middle of the lens.
- Focal Distance: Distance from subject to sensor. Sensor location often marked on top of camera body.
- Image Size and Magnification Ratio: Image size is the actual size of the image on the sensor. If it is half the size of the actual subject, then the ratio is 1:2. If the same size then the ratio is 1:1. If twice as large on the sensor then it is 2:1.

Focal Length and Image Size

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Guide to Focal Length and Focal Distance and Image Size

- Example: When a 50 mm lens (which is ALWAYS 50mm no matter on what camera it is used) is focused at infinity, it is 50 mm between the optical center of the lens (the NODE) and the sensor.
- In order to focus on something closer to the camera, the lens node moves away from the sensor. You may have seen this in prime lenses which get longer as you focus closer. (There are some lens designs which do not change length, but all the techniques discussed work just as well on them). Essentially all the techniques make the lens actually or functionally further from the sensor.

Sensor Size and Cropping

- Cropping. If you take a closeup image and only use a limited part of the image, you effectively are enlarging the result. (That is why they call a 50mm lens on a crop sensor, a 75mm lens-but it really isn't). There will be some loss of detail as you lose pixels.
- When you use a crop sensor camera, you effectively are only using the central part of the image and enlarging the result of the lens by the 'crop factor'. You retain all the pixels of your sensor. You can then still crop as above. Same holds true for M 4/3 sensors.

Sensor Sizes

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36r	nm wide		
		Full Frame 864mm ²	
22mm wide			N
18mm wide	Crop Sensor ~350mm2		4mm tall
Micro Four Thirds 225mm ²	~14mm tall		
iPhone 17.3mm ²			

Depth of Field

- DOF is the distance in front of, and behind the target focal point that retains 'acceptable' sharpness'. It is exceptionally limited in Macro work. Using smaller aperture (large 'f' numbers help, up to a point).
- DOF limitations are minimized when your sensor is parallel to the plane of the subject.
- Advanced techniques for dealing with limited DOF in extremely great enlargements is beyond today's scope.

Techniques to enlarge image on sensor

- 1. Auxiliary Lenses. Attach to the front of any lens. Usually work better on prime lenses than zooms. The strength of Auxilliary lenses is measured in Diopters*. It is the 'power' of magnification. If you use reading glasses, you are using this technique to focus closer than your natural eye lenses can.
- 2. Extending the distance between Lens and Sensor.
 Mechanically increasing the distance of lens from camera body. May be rigid (Extension Tubes) or variable (Bellows).

* Diopter is a unit of refractive power that is equal to the reciprocal of the focal length in meters.

Focal Length and Image Size

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Extension Tubes

Extension tubes are **metal threaded tubes**. Usually in sets of three different lengths allowing various single or combinations of two or all three sections together. Fittings at end connect tube(s) between body and your lens. Inexpensive versions DO NOT connect electronics between lens and body. Lens used with simple tubes MUST have manual aperture controls. Expensive models DO have electronic connections between lens and body. Less than \$10 to many hundreds.

Kenko is a well regarded brand with electronic connections, from about \$100 to over \$200, depending on brand.

Extension Tube set



Reversing Adapters

 Reversing adapters turn your lens around. They work as a short extension, but all lose electronic connections to camera and the lens must be manually adjustable. Another advantage is that it places the subject closer to the lens end designed for best close focus. May use any brand lens. Relatively inexpensive: \$5 and up!

Reverse Adapter on 50mm Lens

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Bellows

Flexible connections between lens and body. Moves on a geared rail. Better versions can move either end making focusing easier. Also aid in maintain the size or perspective of image. Most are manual only. \$30 to \$1005

Bellows (front focus only)



Closeup Lenses (1)

The basic definition of 'Macro' relies on the relationship between the the subject size in relation to the image size on the sensor. With a full format sensor, the image is considered 1:1 when the image covers 24mm x 36mm. My Tamron 90mm Macro focuses down to about 15 inches or about 400mm (40cm) and is then a 1:2 (only half as big on sensor as actual target). When used on a crop sensor it is still not quite 1:1. So it is NOT a TRUE Macro Lens!!! With extension tubes it becomes one!

Specialized Close Up lenses are available. Simply having "Macro" in their title is no guarantee of TRUE macro functions (Ratios of 1:1 or better). You must know the ratio!

Close up lenses (2)

- Working distance. Space between lens and subject. If too short, lens may cause shadows on subject.
- Longer focal length lenses have greater working distance. May be important in many circumstance including lighting, DOF and bothering the subject.
- Shorter focal length lenses have less working distance, but greater magnification.

Auxiliary Lenses

- Simple Diopters. Medium quality. Single element. \$10-30.
 Higher quality. Multi-element. \$60-70 and up
- Raynox Brand. Multi element. Excellent quality. \$60-70.
- Camera Brand specific. More expensive but may be higher quality and more convenient.
- All clamp or fit filter threads on front of your lens. Your lens still works with normal electronic connections to body. Can work on cameras with a fixed lens
- Note: Tele Extenders enlarge your image, retain normal close focus distance of original lens and may be useful (but may lose some fine details). Generic and brand specific models are available. Cost and quality very variable.

+4 Diopter Auxiliary Lens for 52mm Filter Thread



+4 Diopter Auxiliary Lens



135mm Lens with +4 Diopter Auxiliary Lens Focused at Infinity (Actual Working Distance Only a Few Inches)

(3.75 inches across)



135mm Lens with +4 Diopter Auxiliary Lens Focused at Minimum (1.5 meters). Working Distance Same as Previous

(width= 2.75 inches)



Various Sample Images My pointer finger: About 40mm or 1.5 in.



210 mm = 1 3/16 inches



13 mm = 1/2 inch



6.4mm = ¼ inch (over 3:1) (80mm lens with 295mm extension tube)



Advanced Alternative Lenses

- Enlarging Lenses: One special feature of enlarging lenses is they are designed to work with a flat field. This can be useful in macro work since your sensor is flat. Also, these lenses are all manual.
- Microscope objectives: Used with specialized adapters. This type of lens has an extremely shallow depth of field, they are best used with the advanced technique of photo stacking. Not for beginners!

Focusing Aids: VERY important since DOF is very limited

- Camera viewing screen. Particularly valuable if magnified view is available.
- Focusing rails. Moves camera, since lens is extremely limited in further focusing adjustments. Manual and extremely precise motor driven varieties are available. Inexpensive to very expensive.
- Catch IN-FOCUS. Some cameras will fire when focus is optimized. May be useful in some circumstances particularly handheld situations. You move in and out.

Lighting (1)

- Constant lighting. Even with wide open apertures, the light is much dimmer because it is 'spread out'. Cool LED sources, can be valuable for many subjects. I find diffusers are very helpful to 'wrap' the subject with light. Flexible arm LEDs can be convenient, but even LED flashlights can be used. Sometimes point sources of light are helpful.
- High ISO can now be better used with newer sensors and noise-reduction software.
- A successful photographer of insects, lights his subject while it is in a ping-pong ball with small hole for the lens.

Lighting (2)

- When using continuous illumination with typically longer exposures, STABILITY is critical.
- A remote control avoids touching the camera.
- Mirror lock-up and/or the built-in delay timer are also helpful. TEST whether the short (2- or 3-seconds delay) is enough for all vibrations to stop. Otherwise use the longer delay (10-12 seconds).
- If you must use the manual shutter release, set mirrorlockup and squeeze it very s-l-o-o-o-w-l-y to avoid camera shake and the loss of sharpness.

Lighting (3)

 Flash. Electronic flash has advantages of high intensity and freezing movement, particularly in hand-held situations, along with "Catch In Focus". Built-in flashes often have problem with the shadows of the lens, since target is so close. Off camera with good diffusion is desirable.

Diffusers are very important, even for sunlight.

Some Practical Considerations

 Focus by slowly rocking back and forth and *catch* the perfect image. <u>Do not use Auto Focus</u>!!

- Use stabilization if available.
- Use tripod or unipod if conditions permit.
- Use flash, with diffuser, when possible. Low power will recycle more quickly, which is helpful is subject moves.
- Don't be afraid of High ISO, since excellent noise reduction software is available.

Don't be too afraid of high f stops (and diffraction) since excellent sharpening software is available.

Crop Sensor Tamron 90mm (135 equivalent) full image 6000 x 4000 pixels 24 mp



Crop Sensor Tamron 90mm (135mm equivalent) Cropped 3000 x 2000 6mp



Pencil full size with o.7mm lead

LOGO®I 0.7mm JAPAN

Pencil Lead is 0.7mm



Various Additional Tools Some Optional

Full size tripod. Reversible center column.

- Tabletop tripod
 - Sled or other flat surface camera holder
 - Focusing Rail
 - Electronic Flash with Remote
 - Constant Lighting
 - Flash holders
 - Diffusers

Tabletop Trippod



Flexible Flash Holders



Adjustable Manual Rails



Adjustable Flash Attachments



135mm Nikon Lens Adapted to Pentax Tubes



Electronic Flash with Diffuser



24mm Lens with 40mm Extension



90mm Lens with 80mm Extension



Sewing Needle with Thin Thread



Closeup, almost full crop sensor



Monster Bellows

(Just Kidding)



My Real Setup

135mm Lens* (5.25in)
361mm (14in Ext.)
15mm (6in) Working Dist.
Small Slave Flash.

* Screw Mount, Film era SMC Takumar, f3.5



 Full Size: 8.25in x 10.5in
 (210mm x 265mm)

> (Notice Ben Franklin)



1st Closeup: 1.75in wide (45mm)



2nd Closeup:

13/16 in wide; (20mm)

3rd Closeup:

3/8in wide, (10mm)

(Original was 210mm wide)

Wet Hibiscus Center

Center of Orchid About 1:1

Focus Stacked Spider about 10:1

> (from web)

Notes about working in the field

- 1. Additional equipment:
- Diffuser/Reflector; Tripod/Monopod (and focusing styles);
- Backgrounds and a "Plamp II"; or clothes pins or string.
- Remote for camera and flash; or other lighting.
- Spritz Bottle with water (and glycerin).

• 2.Miscellaneous: Sun Protection; Bug Protection; Water!!!

Good News and Bad News

- Not expensive to start
- You probably have most

equipment

- Can be done on a table
- Easy for moderate enlargements
- Some options for cameras with

a fixed lens

Opens new creativity

BAD

Enlarging loses lots of light

Enlarging magnifies flaws in lens

Addiction could become costly

HAVE FUN!!!

