# A Simple, Fast, Accurate Method for Calibrating Focus Offset

May 10, 2014

Andy Goris

Many higher-end DSLRs have a feature for fine tuning autofocus. Nikon calls this AF Fine Tune and Canon calls this AF Microadjustment. On the web it is sometimes called micro focus adjustment. In the camera design business we also call it Focus Offset. There are dozens of excellent articles on the web describing this feature, when it's useful, and how to adjust it, so I won't repeat those concepts. I'm just going to describe my preferred technique.

Having used many techniques, which all work fine, I've encountered three frustrations: (1) they take a long time, (2) most of them require you to look at pictures and judge which one is sharper, where the difference in sharpness is subtle, and (3) they are difficult to do in the field since they require a special target, special hardware, a laptop, or all of the above.

The technique described here is accurate, requires no special targets or hardware, no laptop, and believe it or not, does not require you to take a single picture.

**Theory**

Most DSLRs offer two ways to focus the lens. The first, called *normal focus* or *phase focus* is the default method used when you are looking through the (optical) viewfinder. When you press the shutter button half way, the lens quickly jumps to the best focus position. The second, called *live-view-focus*, or *contrast focus* is how the camera focuses when you are viewing a live image on the display on the back of the camera. When you press the shutter button half way, the camera hunts around for best focus and converges on the best position.

The technique described below takes advantage of the fact that live-view-focus never has focus offset error because the camera is using the same sensor to measure focus as it uses to capture the picture. Normal-focus has the potential for error, i.e. focus offset, because the camera uses a separate, dedicated sensor to measure focus, and if this focus sensor isn't exactly the same distance from the lens (including bouncing off the mirror inside your camera) as the image sensor, the camera will focus a little in front of, or behind your subject.

In the procedure below, you're going to focus first using live-view focus, then focus again using normal focus and watch which way the lens moves when switching from the former to the latter. If the lens doesn't move, your camera and lens are good to go. If the lens consistently moves in one direction in the second step, you will adjust the focus offset until the live-view focus lens position matches the normal focus lens position.

**You will need:**

1. For a focus target, a surface with a high contrast texture that is flat and perpendicular to the camera's line of site. For example, pages from a magazine taped to a wall. If you are outdoors and there is something really, really far away, like a mountain ridge, this can also work as long as the camera and lens see everything at the same distance. For the geeky, any variation in distance within the focus zone should be less than 1/15th of a depth of field at the lenses largest aperture (e.g. f/2.8, f/4, etc). The target should be much larger in the viewfinder than the camera's center focus zone. The little focus squares in the viewfinder are not usually the same size as the actual focus zones. They mainly show the approximate

center of each focus zone, with the focus zone itself being larger than the little squares. Lastly, while you want a focus target that has high contrast texture, avoid things with repeating patterns like a brick wall or chain link fence.

2. Bright light on the target and surrounding area, and bright light on the side of the lens to observe the lens distance scale.
3. A sturdy tripod
4. A solid surface for the tripod, like hard ground or concrete, but not grass, sand, or carpet. If indoors, do this on the ground floor or in the basement. All other floors will shake, either from people moving, the air conditioning equipment, or wind blowing on the building.
5. A remote Shutter Release (optional, but ideal)

**Setup**

1. Put your camera in Aperture Preferred (Av) mode, single-shot focus (not burst), single focus (not continuous focus), and select center focus zone only.
2. If using a Canon camera, turn off Quick mode focus. This is very important. In Quick mode, when your camera is in live-view and you press the shutter button half-way the camera will quickly switch to normal focus, focus the lens, and return to live-view mode. You can hear the clunk of the mirror swinging down and back up. This defeats the whole point of this calibration process since Calibration step (3) requires live-view-focus, not normal focus.
3. Turn off image stabilization. I haven't seen this make a big difference one way or the other, but it guarantees that all of your focus measurements use the same optical path through the lens.
4. If using a zoom lens, move it to the longest focal length. For example, on a 24-105mm lens, zoom the lens to 105mm. If your camera allows you to set a different focus offset for the the near and far zoom position (like the Canon 5D Mark III), then you can calibrate either end first.
5. Place your camera on a tripod and aim it at the target (the magazine or poster on the wall, or the face of a large flat building, your garage door, etc.) The target should be at least 25 times as far away as the focal length of your lens. For example, if your lens is at 100mm, then the target should be at least 2500mm (2.5 meters or 8.2 feet) away. The target needs to be perfectly perpendicular to the line of sight, which usually means the target should be the same height as the camera. Don't stand in your yard and focus up at a window on your house that's higher than the camera. You can stand in your driveway (if it doesn't slope) and focus on your garage door.
6. Read your camera manual and become familiar with the focus offset menu. Again, Nikon calls this is AF Fine Tune and Canon calls this AF Microadjustment. Some cameras allow a different focus offset for each lens, some only offer a single focus offset that applies to all lenses (Pentax?), and some cameras offer both options. I recommend setting a different focus offset for each lens, if your camera offers that option.
7. Study your lens and find where the distance scale is. Point the camera at objects at different distances and press the shutter button half way while watching the lens distance scale. Once you've done this a few times and are familiar with how the lens scale moves during focusing, you're ready to calibrate your camera and lenses.

**Calibration**

1. Put your camera on a tripod, plug in the remote shutter release and turn your camera on. Point the camera so the target covers the center focus zone. Tighten the knobs on your tripod head so nothing moves.
2. Put the camera in live-view mode and verify that the focus zone is centered in the frame.
3. Slowly and gently press the remote shutter release (or focus button on your camera) half way and watch the camera focus. You will notice the camera sort of hunts for the best focus position.
4. Gently push the button to turn off live-view.
5. Now the most important step: look closely at the distance scale on your lens, and while continuing to closely watch the distance scale, half-press the shutter release and see which way the lens moves. The lens should either not move, or jump a tiny amount in one direction or the other. If it wiggles a little after a small jump, ignore the small wiggles as it's the first jump that's important. Note whether the lens jumped towards infinity or towards the close end. You may have to be looking very closely at the distance scale to see lens movement.
6. Repeat Steps 2-5 several times and see if the lens consistently moves in the same direction in step 5. If the lens consistently moves the same direction, you need to adjust focus offset.
7. If the lens doesn't visibly move, for example you just hear a clunk in step 5 but see no movement, then your focus offset is good to go. If the lens moves one way half the time and the other way half the time, your focus offset is good to go.
8. Adjust your focus offset and go back to step 2. If you adjust in the + direction and lens movement in Step 5 gets worse, then try -, and vice versa. The goal is to find a setting where the lens does not move at all in Step 5, or moves randomly one way or the other a small amount.

That's it. On Canon cameras, if the lens consistently moves towards infinity in Step 5, you will want to adjust the AF Microadjustment in the negative direction. If the lens consistently moves in the macro direction, then adjust the AF Microadjustment in the positive direction.

**Final comments**

I have found that the camera's focus algorithms can detect subtler differences in image sharpness than I can by looking at images on my computer. As long as I can see movement in the lens distance scale, this technique is more accurate for me than some of the others I've tried. One of the reasons you repeat steps 2-5 is that the camera will make slightly different choices each time it focuses. This is true for both normal focus and live-view focus. If your focus offset is small, the lens may not move at all, or may move so little it is hard to detect. The more times you repeat, the better feel you will get for whether you need to tune, and which way.

I've used this technique on a Canon 7D and 5D Mark III with many different Canon lenses with good success. I also know people who have successfully used this technique on Nikon cameras and lenses.