Busting the Widely Embraced Myth That Focusing at Infinity Offers Convenience Without Compromise

Michael K. Davis
February 2017

www.AccessZ.com

The INs and OUTs of FOCUS

This link accesses the out-of-print book, in PDF format, **by Harold M. Merklinger**, titled, ***The INs and OUTs of FOCUS***. He is generally regarded to be the originator of the idea that focusing at Infinity can offer benefits over focusing at the hyperfocal distance when the subject space includes objects at Infinity in addition to objects that are closer than Infinity.

Mr. Merklinger writes that when a lens is focused at Infinity, it cannot render objects with any more resolution than the diameter of the aperture itself - as if the entire scene were painted with a brush that is the diameter of the aperture. That's all well and good, if you prefer the convenience of focusing at Infinity, to avoid proper DoF calculations, and find **"fuzzy"** foregrounds to be **"acceptably sharp."**

Many people who read ***The INs and OUTs of FOCUS*** *somehow* come away with the conviction that focusing at Infinity yields a superior (or at least an equivalent) image quality to that had when focusing at the hyperfocal distance. This is not the case and, if anything, only proves that people aren't actually reading Merklinger's book comprehensively.

You have to read the entire book to understand that Merklinger is only pitching his "focus at Infinity" method as a convenient way to avoid the effort required to focus at the hyperfocal distance, but Merklinger makes it clear that this convenience is had at the expense of image quality (in foreground sharpness), or at the expense of shutter speed, or both.

You can find evidence that, despite his having invented this idea of just focusing at Infinity, Merklinger understands that there is useful DoF beyond the plane of sharpest focus (when you focus at Infinity, you are not making use of the very precious DoF available beyond where you've focused) -AND- he understands that CoC diameters can be made small enough to produce sharp images while hyperfocusing. His book does not at all dismiss the fact that hyperfocusing really can produce sharp images. Best of all, his book proves that HE KNOWS his focus at Infinity technique produces compromised images. Stay with me...

Consider his **Rule of Thumb #6 (page 37):** "The zone of acceptable delineation of the subject falls equally in front of and behind the point of exact focus (not 1/3, 2/3!)."

Which prompts me to ask this question: **Why would you want to throw away that *far half* of the "zone of acceptable delineation of the subject" that's available *behind* the plane of sharpest focus (PSF) when focusing at Infinity?**

Answer: You might want to *throw away* that Far half of your DoF range (that lies beyond Infinity) for the *convenience* that comes with *not* having to perform DoF calculations or even *think* about where to focus the lens, while sticking your head in the sand regarding the loss of foreground delineation - which can only be restored by stopping down *two stops further than would be necessary with hyperfocal focusing*, to secure an equally acceptable delineation of foreground subject detail. (i.e. When hyperfocusing yields acceptably small CoC diameters at the Nearest and Farthest subject distances using f/8, you'll have to shoot at f/16 in order to secure the same size foreground CoC diameters, when *conveniently* focusing at Infinity, instead, while *needlessly* securing CoCs for Infinity subjects that are *smaller than can be resolved by the human eye* at the anticipated enlargement factor and viewing distance.)

More on that thought: **Given that we can find "acceptable delineation of the subject" *behind* the PSF, is it not possible that subjects which reside at the PSF (whether focused at Infinity or at a closer distance) will be rendered with *a greater level of detail than can be appreciated* with healthy human eyes when viewing the final enlargement at the anticipated viewing distance?**

Answer: Of course it's possible. We routinely see well-produced prints where greater than 8 lp/mm worth of subject detail are recorded at the PSF, because the smallest CoCs to be found anywhere in the print reside at the PSF! 8 lp/mm (line pairs per millimeter) is the generally agreed limit of human acuity for a viewing distance of 25cm (9.84 inches), equating to 0.86 arc-minute of angular resolution (86/100th of 1/60th of 1 degree of azimuth or inclination). If the final print yields 10 or more lp/mm at the PSF, delineation of subjects that reside at the PSF will be far greater than healthy human eyes can resolve at a viewing distance of 25cm (9.84 inches)! Eagles have eyes that can resolve objects having an angular resolution four times greater than humans: 0.22 arc-minutes.

Is it your goal to produce prints where the resolutions recorded for Infinity subjects can only be perceived by eagles?

Don't lose sight of Merklinger's Rule of Thumb #6 as you continue to read.

Merklinger actually knows that half of the range of acceptable delineation lies beyond the Plane of Sharpest Focus (and so do you)!

Or his **Rule of Thumb #20 (page 71): "The usual depth-of-field scale is calculated for a 1/30 mm circle-of-confusion.** Typical 35 mm films and lenses are capable of delivering a 1/150 mm standard. To convert an existing depth-of-field scale to a new (higher, more demanding) standard, all we have to do is multiply the numbers on the depth-of-field scale by the improvement factor we desire. To go for that five-fold possible improvement, multiply all the numbers by 5: Instead of f/2, read f/10. Alternatively, divide the f-number you are actually using by 5 and look for that spot on the existing depth-of-field scale: if you are using f/11, look for the f/2.2 depth-of-field mark. And, if you wish, **you can use different standards** for the far limit of depth-of-field and for the near limit."

The first quoted sentence says it all – that the engraved DoF scales seen on many 35mm format (24x36mm) lenses, are calculated to deliver CoC diameters no larger than 1/30mm (0.03mm) at the Near and Far limits of the subject space. This is true for many DoF calculators and tables designed for the 35mm format, where users are not given an opportunity to specify a maximum permissible CoC diameter of their own choosing.

The entirety of **Rule of Thumb #20** reveals that Merklinger *knows (and is teaching his readers)* that DoF calculations *should be customized* by specifying a maximum permissible Circle of Confusion diameter that *smartly* accommodates the anticipated enlargement factor and our a personally desired final print resolution, which itself should incorporate the anticipated viewing distance. Merklinger hasn't said it overtly, but it's clear that he is warning his readers that the traditional, maximum permissible CoC diameter of 0.03mm (for the 35 mm format) could be found disappointingly soft at the Near and Far limits of the subject space, when viewed in prints that are either too large or viewed too closely. Similarly, the traditional maximum permissible CoC diameter of 0.06mm, for medium format cameras, could be found disappointingly soft.

Sadly, Merklinger makes no mention of *how* users should go about determining a *custom* maximum permissible CoC diameter for use with DoF calculations that will suit their individual requirements! Hint: Use the equation provided in the Wikipedia article, Circle of Confusion:

Max. Permissible CoC Diameter = viewing distance (cm) / desired final-image resolution (lp/mm) for a 25 cm viewing distance / enlargement / 25

But you can also find statements like this in Merklinger's book:

From **page 21**: "In general, I have found the results obtained using the time-honored methods usually yield backgrounds which are on the fuzzy side."

Here's where his choice of words become somewhat ambiguous or vague - I suspect this is done intentionally in an effort to *push* the idea of using his novel focusing method. It's either that or he is simply negligent in failing to qualify his statements more carefully. **What does he mean by "time-honored methods?"**

Answer: He cannot be dissing the **"time-honored"** use of hyperfocal focusing, in general, having written Rule of Thumb #20, where he admits that the maximum permissible CoC diameters can be customized for use in DoF calculations.

If Merklinger's writings are to be interpreted as both coherent and consistent, we *must* conclude he is dissing the "time-honored" use of a *fixed* value of 0.03mm (1/30th mm) as the CoC diameter used

to calculate DoF for the 35mm format (or a diameter of 0.06mm for medium format, etc.). He is *not* dissing the "time-honored" use of hyperfocal focusing!

Given his choice of words, **the reader might be misled into forgetting about his Rule of Thumb #20 – as if only <u>one</u> maximum permissible CoC diameter can be specified for any given format, in DoF calculations performed for hyperfocusing.**

Rule of Thumb #4 (page 36): "If we want anything at infinity to be critically sharp, focus at Infinity."

That doesn't jive with Rule of Thumb #6! Why would you focus at Infinity if "The zone of ACCEPTABLE delineation of the subject falls equally in front of and behind the point of exact focus?" If you find that your DoF calculations and hyperfocusing produce *<u>acceptably small</u>* CoCs (or "disks of confusion," as Merklinger calls them), with foreground subjects, why wouldn't these same sized CoCs be found acceptable beyond the plane of exact focus - in the background?

The only circumstance where either the foreground subjects or the background subjects could be found *unacceptable* when adhering to DoF calculations is when the CoC diameter specified for the DoF calculation was unacceptably large for your resolution goals in the final print, after enlargement, at the intended viewing distance!

Consider the possibility that your chosen maximum permissible CoC diameter at the film or sensor plane, as used for DoF calculations, yields CoCs in the final print, after enlargement, that are never larger than is necessary to deliver subject detail at 8 lp/mm – the generally agreed limit of human visual acuity at a viewing distance of 25cm. **What benefit could possibly be enjoyed by securing even higher resolutions at the Near or Far limits of the subject space – as when focusing at Infinity? Every subject that falls between the Near and Far limits of DoF, when hyperfocusing, would be rendered with a resolution equal to or greater than 8 lp/mm, including Infinity subjects.**

Now, if your personal resolution goals are not so extreme, but rather, more reasonable, at something like **4 lp/mm** in a final print to be viewed at distances as close as 25cm, you will still find Infinity subjects to be rendered with *acceptable* resolution, when hyperfocusing via the use DoF calculations that specify a maximum permissible CoC diameter that is **half** that required to achieve **8 lp/mm** in a print of the same size, for the same viewing distance.

The choice of CoC diameter for DoF calculations is *<u>yours</u>* – as Merklinger has stated in his Rule of Thumb #20.

And his **Rule of Thumb #23 (page 72):** "A gentle repeat reminder: when you focus at the hyperfocal distance, you are guaranteeing that subjects in the distance will be resolved **no better than your specified minimum standard**. In order to improve upon this, you must focus beyond the hyperfocal distance."

Here he suggests the possibility that we can use a standard of our own choosing - **"your specified minimum standard"** (a la **Rule of Thumb #20**) - but when he mandates that we **"must focus beyond the hyperfocal distance"** to improve the resolution of distant subjects, ***<u>he is either neglecting to mention OR he is intentionally obscuring</u>*** a critical point:

If our "specified minimum standard" (see Rule of Thumb #20) was aggressive enough to begin with (if we had calculated DoF to secure *smaller* CoC diameters), we wouldn't feel moved to sacrifice foreground resolution while obtaining background resolution (while focusing at Infinity) that's needlessly *greater than* can be perceived or, at least, greater than is *necessary* to be found *acceptable* in the final print (depending on how *relaxed is your personal resolution goal for the anticipated enlargement factor at the intended viewing distance*).

And in his **Summary, Chapter 11 (page 73)**: "**The traditional depth-of-field philosophy usually ends with the advice: to maximize depth-of-field, choose a moderately small lens opening, set the focus to the hyperfocal distance, and shoot. My parting advice would be a little different.** For typical normal and wide-angle lenses, especially lenses having focal lengths less than about 50 mm no matter what the camera format, set the lens opening to somewhere in the 2 mm to 5 mm range, set the focus at infinity, and shoot. For lens openings larger than 5 mm, and for longer lenses that tends to mean all normal working f-stops, focus on what is critically important."

Focusing at infinity cannot be done without forfeiting the DoF that resides beyond the plane of focus (Merklinger's Rule of Thumb # 6), thus the aperture you must chose to adequately resolve foreground subjects when focusing at Infinity will be two stops _smaller_ than that which could be used if hyperfocusing instead!

Merklinger not _only_ pitches his idea of focusing at Infinity, he _also_ pitches the idea of putting up with soft foregrounds – with a head-in-the-sand approach of _not_ stopping down any farther than you would when hyperfocusing and, thus, to just _tolerate_ _inadequately detailed_ foregrounds.

Where does he say this?

Keep reading...

Under a photograph of a church with flowers very near in the foreground **(page 60)**, he writes: "Taken with a 28 mm lens at f/11, infinity focus provided all the depth-of-field necessary."

Without question, if he is actually *content* with the final CoC diameters in the foreground subjects, when using f/11, he could have hyperfocused and been *just as content* with his infinity subjects at f/5.6, where the DoF that resides beyond the plane of focus (beyond Infinity?) could have been pressed into service instead of wasting it! And if he were to shoot at f/5.6 while hyperfocusing, instead of shooting at f/11 while focusing at Infinity, his shutter speeds would be 4x faster!

On page 68: "Since working out these details, I find I do a lot of photography with the lens simply focused at infinity."

But Merklinger admits that the convenience comes at a price...

From page 22: "Objects photographed up close can still be recognized even if they are a little fuzzy. Objects in the distance may need to be very sharply imaged if they are to be recognized at all."

From page 48, under the infamous cannon and village picture: "The cannon, the grass, the gravel, and the trees are clearly a bit fuzzy, but we have no difficulty in recognizing them." You've got to laugh at that: **"clearly a bit fuzzy."** ☺

From page 66: "Experimenting, I learned that with the lens focused at infinity, things up close still seemed to be adequately sharp."

Unstudied users of the Merklinger method should take note that he, in writing, that his infinity focus method produces foregrounds that are "recognizable," "a bit fuzzy," "a little fuzzy, or "seemed to be adequately sharp."

Is that _your_ goal? Do you really want to make prints rendering distant objects with detail so great your eyes are likely incapable of resolving it, while simultaneously securing resolutions for near objects that are only just "recognizable" or "clearly fuzzy" or "a bit fuzzy"?

Let that sink in. Merklinger understands and is telling us, with a somewhat cavalier choice of words, that focusing at Infinity is a compromise that is found acceptable only if you are willing to suffer "fuzzy" foregrounds in favor of excessively detailed Infinity subjects and, as has been proven appealing to the most ignorant of photographers, a very _convenient_ way to set focus and select aperture.

The fact remains that everything in the shot can be made at least as sharp as his Nears at a wider aperture (faster shutter speed) than Merklinger is using - by focusing more closely than at Infinity. And, despite his at-first-glance negative comments about traditional methods of focusing, his own **Rules of Thumb #6 and #20** reveal that he _knows and is teaching the reader_ that one can achieve acceptably sharp Nears AND Fars by hyperfocusing for a smaller CoC diameter.

Merklinger's method boils down to this: If you are willing to take a big hit in foreground sharpness by wasting the DoF that lies beyond the plane of sharpest focus, _you can put convenience ahead of_

image quality **by focusing at Infinity and selecting an aperture that's just small enough to make foreground subjects only "recognizable" or "clearly fuzzy."**

If you want the convenience of focusing at Infinity AND the foreground sharpness had when hyperfocal focusing, you will have to suffer these compromises:

1) **Stopping down further than you would with hyperfocal focusing (because you're throwing away all the DoF that lies beyond the plane of sharpest focus).**

2) **Shooting at the slower shutter speed that comes with using a smaller aperture.**

3) **Increasing your risk of inducing visible diffraction across the entire image.**

Again, I have to laugh!

☺

How do people who read this book, overlook Merklinger's own testimony, that foreground resolution is *compromised* when focusing at Infinity, unless you stop down farther than you would when hyperfocusing?

Answer: The unschooled photographer very much wants to believe he can get something for nothing!

No thanks! I'll stick with using depth of field calculations customized with a well-considered maximum permissible CoC diameter. The half a minute required to use a depth of field calculator will not only tell me at what distance to focus, but will also give me the widest aperture (and therefore, the fastest shutter speed) capable of delivering the CoC diameters necessary to support my desired print resolution for an anticipated enlargement factor and viewing distance.

Again, $1/30^{th}$ mm (0.03mm (is the **"traditional"** CoC diameter for full frame (24x36mm film or sensors) to which Harold Merklinger refers in his **Rule of Thumb #20**. It was used for lens barrel DoF scale engravings on lenses made for 35mm format film and is the value used in most DoF calculators and tables for any full frame sensor digital**, but... you have the option of using a DoF calculator that allows *YOU* to specify a custom CoC diameter.**

Many full frame shooters unknowingly use a maximum permissible diameter of 0.03 mm for the Near and Far limits of DoF (as recorded at the film or sensor plane) when performing DoF calculations and focusing at the indicated hyperfocal distance. **Not surprisingly, they can find 0.03mm CoCs to be unacceptably soft (especially at the Far Limit)** with enlargement factors greater than or equal to 8.5x (with 8x12-inch and larger prints from full frame captures) when viewed at distances as close as 10 inches.

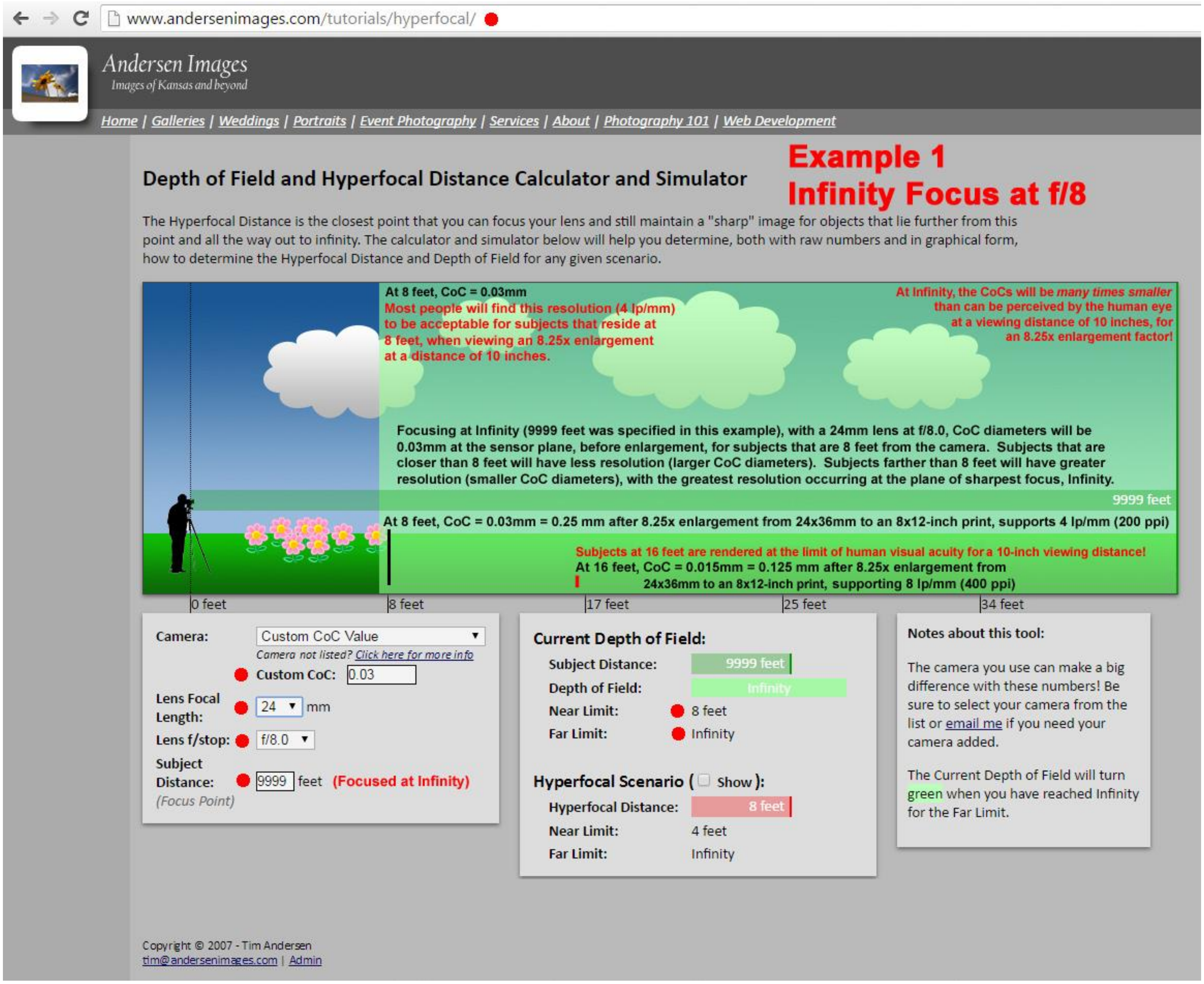
People have become disenchanted with hyperfocal focusing, not because there is something intrinsically wrong with the equations that describe DoF, but simply because they were performing their DoF calculation with a CoC diameter that is too large to satisfy their personal expectation for final image resolution at an anticipated enlargement factor and viewing distance. Most photographers who have experienced disappointment with DoF calculations have had no awareness of the possibility of specifying a custom CoC diameter with DoF calculators that permit user specification of the variable.

Using the equation given at https://en.wikipedia.org/wiki/Circle_of_confusion, a maximum permissible CoC diameter for use in DoF calculations can be determined as follows:

Max. CoC (mm) = anticipated viewing distance (cm) / desired final-image resolution (lp/mm) for a 25 cm viewing distance / anticipated enlargement factor / 25

The desired final-image resolution (in lp/mm) is the variable that allows YOU to customize the DoF calculations to satisfy YOUR expectation for a final image resolution (at your anticipated enlargement factor and viewing distance).

Have a look at these annotated screenshots taken while using **Tim Andersen's** excellent utility at http://www.andersenimages.com/tutorials/hyperfocal/.



In this screenshot of Tim Andersen's DoF and Hyperfocal Distance Calculator and Simulator, I've specified a **Custom CoC** value of 0.03mm - which is actually the same as that which he specifies for a Canon 5D Mark II and all other full frame bodies, but I wanted the CoC diameter to be displayed for this discussion.

As his DoF calculations and the resulting graphic show, when focused at Infinity (9999 feet), CoCs no larger than 0.03mm will be recorded at a Near Limit of 8 feet, when using a 24mm lens at f/8.0. We can easily calculate that after 8.5x magnification, to produce an 8x12-inch print from a 24x36mm sensor, the Near Limit CoCs will measure 0.255 mm - which supports a print resolution of **4 lp/mm** (= 1 / 0.255mm) or 200 ppi (= 4 * 50 ppi).

4 lp/mm (200 ppi) is easily good enough for most people's expectations when viewing a print at a distance of 25cm (10 inches). And because, in this example, we are focused at Infinity, the CoCs only get (needlessly) smaller as we move toward Infinity, the CoCs quickly become much smaller than the 0.125mm diameter that would support a print resolution of 8 lp/mm (400 ppi) - which, for an 8x12-inch print viewed at a distance of 10 inches, would equate to an angular resolution of 0.86 arc-minute, the generally accepted limit of human acuity.

In fact, for this example, above, 0.125mm diameter CoCs (8 lp/mm or 400 ppi) will be achieved in the 8.5x enlargement at subject distances of only 16 feet from the camera - at only twice the Near Limit subject distance of 8 feet, where only 4 lp/mm (200 ppi) is supported. Thus, every object in the scene that resides at distances farther than 16 feet from the camera will be recorded with

CoCs that are smaller than is humanly possible to appreciate, when viewing an 8x12-inch print at a distance of 10 inches (or a 16x24-inch print from the same capture, at a distance of 20 inches)!

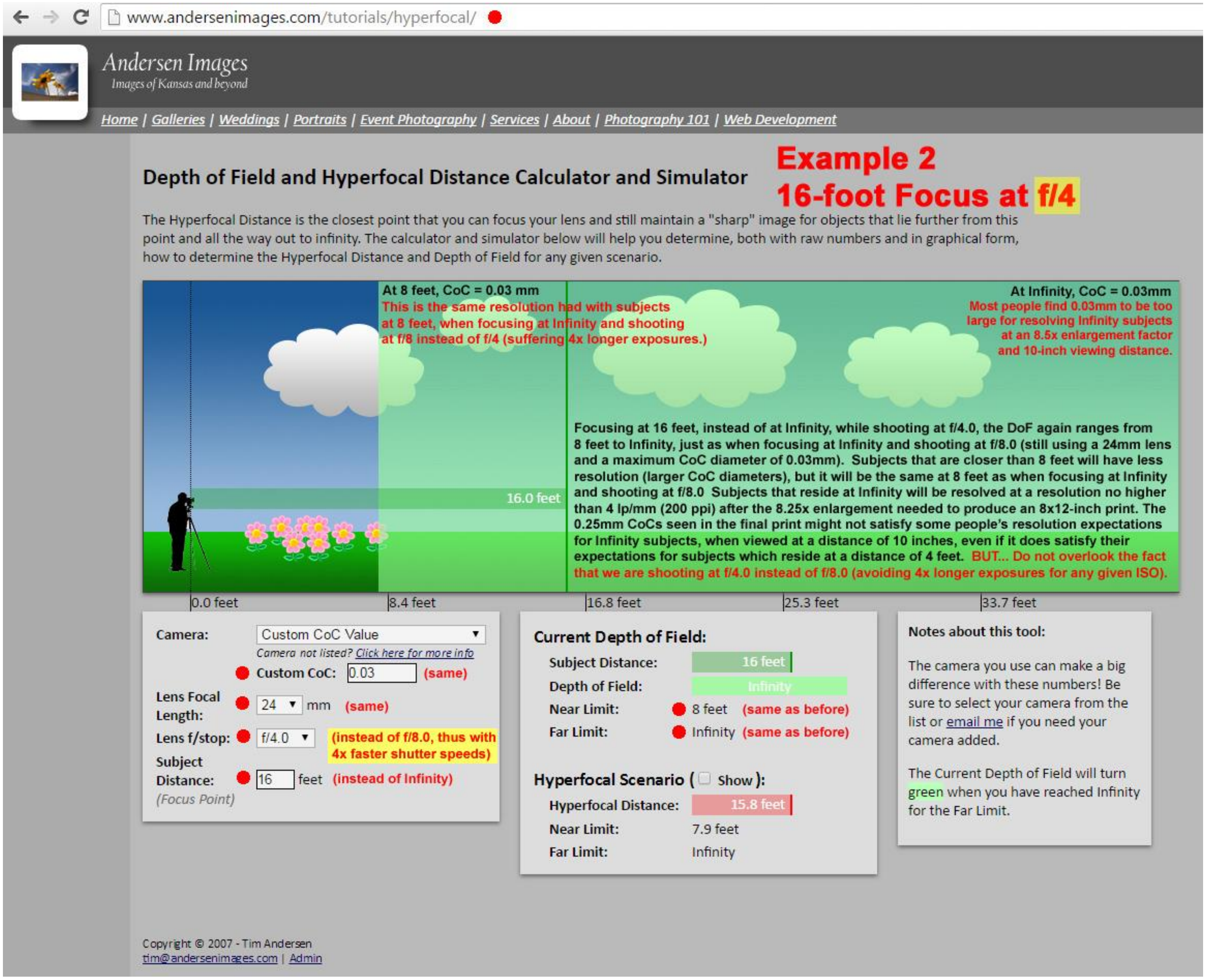
The CoCs recorded for subjects that lie beyond 16 feet would require visual acuity much less than 0.86 arc-minute of angular resolution. Again, Eagles have eyes that resolve four times more detail than humans - with 20/5 vision vs. human 20/20 vision - they have eyes that can resolve down to 0.22 arc-minute (32 lp/mm or 1600 ppi at a viewing distance of 10 inches), but even an eagle would be ***unable*** to appreciate the CoCs recorded in this example for objects that reside farther than 64 feet from the camera!

That's how *needlessly small* the CoCs become when focusing at Infinity, while shooting at f/8.0 with a 24mm lens, when the intent is to produce 8x12-inch prints for viewing at a distance of 10 inches (or 16x24-inch enlargements for viewing at 20 inches).

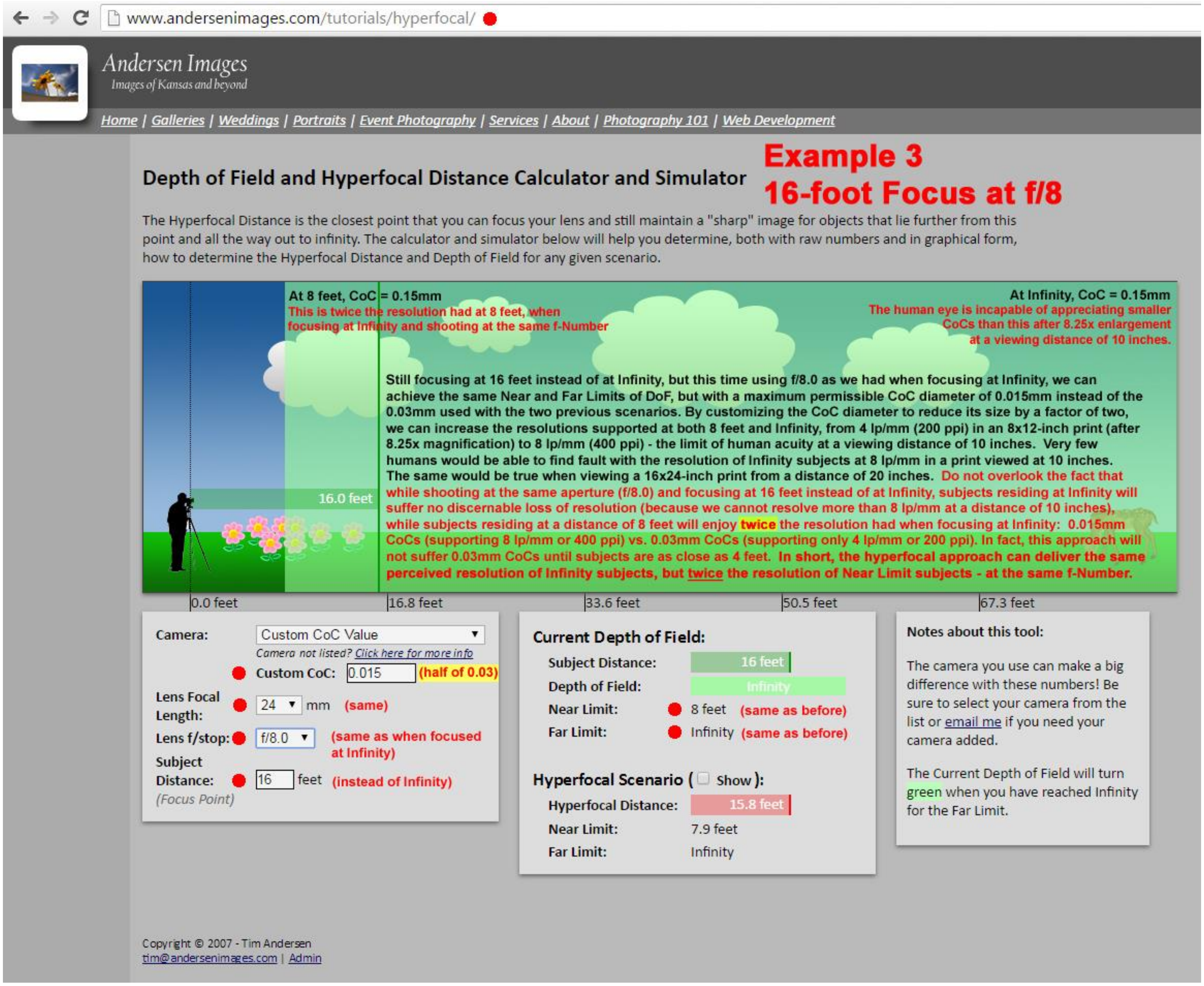
In short, the hyperfocal method can deliver the *same perceived resolution* of Infinity subjects, but *twice the resolution of Near Limit subjects*, when shooting at the *same f-Number*, for the *same enlargement factor and viewing distance*, as compared to focusing at Infinity.

Focusing at Infinity, the user would have to stop down to f/16 to secure 0.015mm CoCs (8 lp/mm) with Near Limit subjects residing at 8 feet, while suffering 4x longer exposures than possible at f/8, with no perceptible increase in the resolution of Infinity subjects (because our eyes cannot resolve more than 8 lp/mm at a viewing distance of 10 inches (or 4 lp/mm at a viewing distance of 20 inches.)

Study this next annotated example, where a focus distance of 16.0 feet is selected instead of focusing at Infinity, while shooting at f/4 instead of f/8 – yielding 4x faster shutter speeds:



Now examine this third annotated example, where a focus distance of 16.0 feet is selected instead of focusing at Infinity, while shooting at f/8, to deliver CoC diameters no greater than 0.015mm – the same aperture (and thus, the same shutter speed) that was used in the first example (when focusing at Infinity with f/8):



If you've actually studied these examples and still don't get it, you're just not going to get it (sigh), but the equations I've provided, above, and the DoF math incorporated into Tim Anderson's superb tool (and many other DoF calcualtors), ***can*** be trusted.

Math is used to describe many phenomena that occur in the real world. I've tested these age-old equations thoroughly. They work just as they predict, but ignore just one variable and the whole thing falls apart. You must be precise in measuring the distance to the Near subject and in focusing at the DoF calculated focus distance.

Hyperfocal focusing requires precision, not sloppiness. The pay-off, relative to focusing at Infinity, is 4x faster shutter speeds or two additional stops worth of DoF at the same shutter speed - your choice - per my examples, above. Hint: [I use a laser range finder ensure this precision](#).

Very few of the legions of photographers who have become disenchanted by hyperfocal focusing did so with any understanding that they should have adjusted their DoF calculations to deliver a maximum permissible CoC diameter that is tailored to the anticipated enlargement factor and their personal, desired final image resolution, which should incorporate the anticipated viewing distance. In short, they are not using the equation given in the Wikipedia *Circle of Confusion* article, as provided above.

There is absolutely no need to secure CoCs that are smaller in the final print than healthy human eyes can resolve (8 lp/mm) at the final enlargement factor and viewing distance or, for that matter, that are smaller than necessary to secure *YOUR* desired final print resolution (which could be less than 8 lp/mm). But that's exactly what you get when you focus at Infinity - CoC diameters that are *much smaller than necessary* for distant subjects and - as Merklinger himself admits in his writings - CoCs for near subjects that are only small enough to leave them looking "clearly fuzzy" but still "recognizable" - unless you stop down two stops below the f-Number that could have been used for the same sized CoCs had at the limits of DoF when hyperfocusing.

Some people who cling to the convenience of the Merklinger method have deduced through experimentation that they can get better results in the near field by focusing somewhere just short of Infinity. They're right, of course, but I can't help but pity their ignorance!

What good is focusing "just short of Infinity" when they should be focusing at 2x the Near distance (hyperfocusing) for scenes that include Infinity, while enjoying their choice of A) two additional stops worth of DoF to get Nears and Fars that meet their personal desired resolution requirement for the anticipated enlargement factor and viewing distance or B) 4x faster shutter speeds?

There are no free rides in photography. Convenience always comes at a cost!

My advice to those who *refuse* to calculate CoCs for use in DoF calculations that are realistic for their personal needs (in terms of desired final image resolution, anticipated enlargement factor and viewing distance), **would be to increase your IS0 setting by two stops from whatever you've been using for any given lighting situation** (i.e from 100 to 400 or from 800 to 3200), then focus at Infinity - no thinking required (that's the point, right?) - **using the slowest shutter speed you suspect you can get away with**, taking into account camera and subject motion and whatever image stabilization your rig offers. Except for the decrease in SNR that comes with using higher ISO settings (the price you will pay for convenience), you'll be a lot happier with the detail in your Nearest subjects when pixel-peeping 100% crops at enlargement factors that greatly exceed the prints you're likely to make - and thus, you might end up with a print that looks as good as one that was properly hyperfocused using precisely honored DoF calculations that are based on a properly calculated maximum permissible CoC diameter.

It is very easy to reach the wrong conclusions when attempting to compare the Merklinger method to hyperfocusing, as the effort will be rendered useless if hyperfocal focusing is improperly executed. Everyone knows how to focus at Infinity, but relatively no one uses a properly calculated maximum permissible CoC diameter when performing and adhering to DoF calculations.

As I pointed out in my reply to this Digital Photography Review forum thread - where a poll was conducted showing that more people preferred to focus at Infinity for deep depth than people who prefer hyperfocusing... **There was absolutely no discussion of what CoC diameters were used for DoF calculations, nor for what enlargement factor, nor for what viewing distance, nor for what personally desired final image resolution, nor even what size prints they used**

(leaving out the other significant factors), which, of course, suggests that every participant FAILED to hyperfocus correctly!

I am utterly convinced from reading many such forum discussions, not only at DPReview, that most people rely on pixel-peeping their captures at 100% on their computer monitors. They therefore reach conclusions and make decisions based on examination of captures at HUGE enlargement factors, the likes of which they may *never* produce prints. And typically, the larger the print, the farther back a person will stand to view the print, so there again, they are examining their 100% crops on the computer screen at distances that are much closer than the distance at which so large a print would normally be examined!

In short, we have seemingly *universal ignorance* governing the conclusions that people reach regarding defocus and diffraction (i.e. how common it is to see everyone agreeing that a given camera body starts to suffer degradation due to diffraction at a *specific* f-Number, with that consensus being reached without *anyone* stating the enlargement factor and viewing distance for which they find f/8, for example, to be the f-Number one should never exceed, due to the effects of diffraction).

Sadly, with their improperly quantified fear of diffraction, legions of well-intentioned, passionate photographers are confining themselves to shooting with wider apertures than necessary for the enlargement factors and viewing distances at which their final images are likely to be displayed. They are therefore ending up with insufficient DoF for their compositions or they are recomposing the scenes, backing away from the Nears or changing to shorter focal lengths, so that their DoF calculators will give them the green light to shoot at the ridiculously small f-Number, beyond which diffraction only becomes visible in 100% crops viewed on their computer monitors at very close distances!

I must therefore vigorously recommend that there is no point in "comparing" Infinity focusing vs. hyperfocal focusing, unless you are willing to discipline yourself to conduct tests that control all the variables affecting the results.

It's easy to focus at Infinity and observe that Infinity subjects have crazy amounts of detail when examining a 100% crop. It's relatively difficult to accurately focus at the hyperfocal distance and perform DoF calculations that are scaled to deliver a maximum permissible CoC diameter that was calculated correctly, not just a one -size -fits -all CoC value that's assumed to be “good enough” for a given film format or sensor size, to come up with an f-Number that will very precisely deliver CoCs no larger than the DoF calculations predict - not in a 100% crop at some outrageous enlargement factor, but rather, at the enlargement factor you anticipate in an actual print you produce for viewing no closer than the distance you specified when calculating the CoC diameter used in your DoF calculations - a print that can be compared side-by-side with a like-sized print, viewed at the same distance, made from a capture where the lens was focused at Infinity using the same f-Number as that indicated by your DoF calculations (with the same ISO and shutter speed.

If you're not able or willing to do all of that, then you'll be reaching false conclusions about hyperfocusing and the efficacy of DoF calculations vs. the ever-so-convenient Merklinger method.

As I've stated previously, above…

Using the equation given in the Wikipedia Circle of Confusion article, a maximum permissible CoC diameter for use in DoF calculations can be determined as follows:

Max. CoC (mm) = anticipated viewing distance (cm) / desired final image resolution (lp/mm) for a 25 cm viewing distance / anticipated enlargement factor / 25

The desired final-image resolution (in lp/mm) is the variable that allows YOU to customize the DoF calculations to satisfy YOUR expectation for a final image resolution (at your anticipated enlargement factor and viewing distance).

I recommend you rehearse what you intend to do in the field by playing with Tim Andersen's DoF and Hyperfocal Distance Calculator and Simulator. You might even set out to produce two 8x10 or 8x12 prints for comparison, that emulate my Example 1 and Example 3 images, above:

Lastly, you can determine the f-Number at which diffraction's Airy disks would reach the same diameter as your calculated maximum permissible CoC diameter by using this equation:

Diffraction-Limit f-Number = Max. Permissible CoC Diameter / 0.00135383

For the source of this equation, see: http://photo.net/learn/optics/lensTutorial#part4

Looking at these two equations, it should be obvious that both the CoC diameter (blur due to defocus) and the Airy disk diameter (blur due to diffraction) can be larger when the viewing distance is increased or the enlargement factor is decreased or the desired final image resolution is decreased. Conversely, both the CoC diameter and the Airy disk diameter must be made smaller when the viewing distance is decreased or the enlargement factor is increased or the desired final image resolution is increased.

That's why any DoF calculator that uses a CoC diameter selected without consideration of viewing distance, enlargement factor and desired final image resolution has a very good chance of disappointing the user.

And that's why any single f-Number that a *consensus of ignorance* has concluded should never be exceeded for a given camera body also has a very good chance of disappointing the user.

Do the math and conduct your tests with diligence or forget about it and take your chances like most people do, drawing false conclusions while claiming they've "tested it." The choice is yours.

Also see: ***Using Hyperfocal Distance Effectively in the Field***

Disclaimer: This discussion has ignored other factors which limit final image resolution, including: pixel count or film resolution, lens resolution, losses caused by the RGBG Bayer algorithm and AA filters of CMOS sensors, camera motion, mirror slap, lens resolution, film flatness, etc. Here, we have only discussed the impact of defocus and diffraction on image resolution.