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Wednesday, 02 March 2011

Why My Gigabyte Film Scans Might Not Be Good Enough

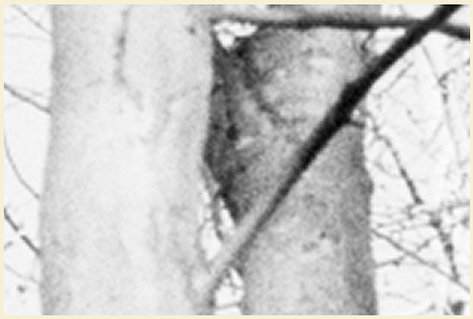
By **Ctein**

Last week, in some comments to Mike's "Touch Once" post, I mentioned that I was on my fourth round scanning some of my film and that re-scanning my film seems to be something I have to do about every five years despite my best efforts to make scans so good that I could never imagine needing better ones. (Apparently, my wildest imaginings have a tangible expiration date.) This, of course, raised questions about how good a film scan really needed to be, and so here we are.

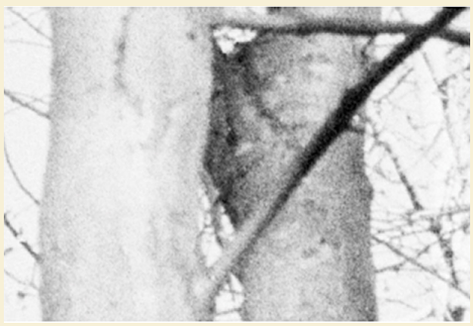
I'm close to wrapping up the task of scanning all the undigitized negatives of the photographs in my dye transfer portfolio. After several weeks of work, I've got a folder of image files that's about 100 GB in size. That's what happens when almost all your work is medium format negative and you're scanning it at 16 bits per channel color depth at a pixel pitch of 4800 PPI. My average file size tops three quarters of a gigabyte. Shouldn't this be enough for anybody?

Well, I really hope so. I don't look forward to repeating any of this five years from now; I truly can't imagine why I would have to. The problem is that I'm pretty sure these aren't the best of all possible scans. That leaves the door open to the possibility that at some time in the future I will come up with some unimagined need that demands even better scans. Be afraid, be very afraid.

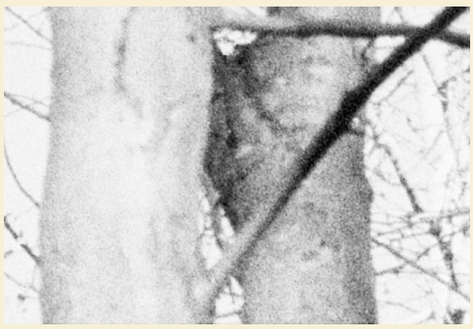
The problem lies in the resolution. Forty-eight hundred PPI crisply images film grain, but it doesn't actually resolve it. What's the distinction? Point your digital camera at the night sky and open the shutter for a few seconds. You'll photograph stars, but the stars themselves are thousands of times smaller than an individual pixel in your camera. The stellar image expands to fill a pixel with some average level of brightness, but it's not resolved.



1200 PPI scan (click on these images to see them larger; the auto-resizing of the blog software obscures the sharpness of the images a bit). You can image film grain at remarkably low scan resolutions, as these comparison photos of TMAX 100 film scans show. An image of film grain, though, is not the same as resolved film grain.



2400 PPI scan



4800 PPI scan

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Film grain is extremely small, even in coarse-grained films. Forty-eight hundred PPI scans don't resolve it. What you get are little square pixel-sized blobs in place of the original grain that mimic the pattern of the grain.

So what? Well, there are some subtle kinds of image degradation that occur when you don't sharply resolve grain. Good darkroom printers are familiar with the effects that occur when a print is just a bit out of focus or made with a less than a top-notch enlarging lens. Edge acutance gets subtly altered. More visibly, tonality and gradation in the extreme highlights and shadows gets distorted or muddied, because those tiny individual film grains (or spaces between grains) have a disproportionate effect on tonal rendition at the extremes.

The situation is not quite the same for film scanners, but it's close enough that there are issues to worry about. The losses are small; I think they may never matter to me. But there's that demonstrated lack of future imagination.

How much scan resolution would it take to satisfactorily resolve the film grain? I don't really know. The late Bruce Fraser and I discussed this on occasion, and we guessed the scans would have to resolve in the 10,000–15,000 PPI range, but neither of us ran any tests. I'd be looking at 5–10 GB scan files, and that would give pause even to Lloyd Chambers' uber-Mac.

There are other practical issues. Scan pitch is not the same as scan resolution, It's only the upper limit on the resolution. The real resolution is somewhat less, due to losses in the optical train. (A cautionary note there for any readers who want to report on their ultra-high-resolution scans. Do you know what resolution you're *really* getting?) I'm fortunate. I've tested my Minolta Dimage Multi Pro scanner, and it resolves 4200 PPI in the center of the field and 3800 PPI at the edges. 80–90% of theoretical resolution at a scanner's upper limit is very good performance.

Thing is, if I had a scanner that delivered 10,000–15,000 pixels per inch, I have to come up with new measurement tools to find out what was actually resolved. Nothing in my experimental arsenal is good enough. For all I know, there aren't even any film scanners of any type out there that can resolve 10,000 PPI, manufacturers claims notwithstanding.

If the gods choose to smile on me, I'll never have to answer these questions. All I can know for sure is that there is information in the original negative that I'm not capturing in the scans, and all I can do is hope that I never need to care.

Ctein

Ctein's regular weekly column appears on TOP on Wednesdays.

Posted on Wednesday, 02 March 2011 at 09:11 AM in Ctein, Digital Techniques, Film and Darkroom | Permalink

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Comments

Good enough for what?

Posted by: George LeChat | Wednesday, 02 March 2011 at 09:28 AM

Ctein, I'm convinced I should not post this, as your theoretical background draws big circles around mine. But still, I can't avoid it (and I guess Mike will understand me):

This article reminds me of the old, neverending discussions in audiophile circles on digital music vs analogue music. And the analogy would be this one:

Say you have a top-notch highest-grade turntable system and a big collection of highest quality vinyls, conserved under the very best conditions along the years. Say most of them are collectors item, unavailable anymore. Say you are very fond of those recordings.

At some point in the early 90s, you made audio transfers to the (then) absolute best digital equipment, possibly DAT. You were convinced it was it, nothing required to do in the future. Yet after some years, newer, better quality digital gear became available to you, so you did new transfers of your beloved vinyls, that time to CD. Then, after some more time, you reached 96 khz audio gear, enabled to extract even the very finest details from your vinyls. There you go again... and again, and again, as far as you keep on being alive.

My point: as far as you want to bring analogue (= by definition, continuous streams of information) into digital (= by definition, discontinuous streams of information), you will remain forever doing updated transfers of your analogue files, be it pictures, songs, or movies. The digital domain will keep improving forever.

Therefore, I think the reasonable thing to do is to make updated transfers until the point you personally are unable to make any difference between the transfer and the original file. Once you pass that line, you start suffering an illness. ;)

Posted by: Cateto/Jose | Wednesday, 02 March 2011 at 09:38 AM

Ctein,

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as I read this all I could really think about was "diminishing returns" and some photographic interpretation of the Pareto principle. I feel your pain, by the way: 20% of my marketing budget achieves 80% of my aims, yet consumes only 20% of my working year. The other 80% of the time is consumed with arguing the minutiae and chasing the data to justify spending the remaining 80% of money on the final 20% of aims, with people who split neatly into 80% idiots and 20% geniuses.

Wouldn't it just be enough to achieve "a good representation" of a negative by scanning, for cataloguing and archiving purposes, and have sitting in the corner a proper old-fashioned enlarger for when you actually want to make your best prints? Reading between the lines, I think your next 5-yearly endeavour to extract the maximum from your negatives is going to be in 2016, with 200 GB scans, that you are going to repeat in 2021, 2026....

Posted by: James | Wednesday, 02 March 2011 at 09:43 AM

"Be very afraid" is right. The physical limit to resolution using light and "perfect" lenses is around 250 nm (billionth of a meter) or about 100 thousand PPI.

Posted by: Phil Allen | Wednesday, 02 March 2011 at 09:51 AM

Well Ctein,

My Nikon CS V ED/LS 50 is a SOTA scanner these days (although it is discontinued 3 years ago and new old stock fetches top dollars these days as is youre Minolta btw.) but the best in business are the Hassy's (for non drum scanning) that is at 6100 and 6900 dpi optical resolution (at a mere 20.000 euro for the later).

http://www.filmscanner.info/HasselbladFlextightX5.html (in German)

But this holds only true for 35mm, for medium format they use 3200. Now wasn't Hassy in medium format business? So I don't see that much development in the Scanner market these days.

Greetings, Ed

BTW, next saturday I book will arrive.....nice!

Posted by: Ed | Wednesday, 02 March 2011 at 10:14 AM

This is seriously frightening as if Ctein has become obsessed with simply collecting data. Rescanning already massive film scans, or even thinking about doing so in the future is like exhuming bodies to give them a better burial. My prescription for this is to restrict his image making for the next year to using a Holga. Obviously resolution is overrated in my book. Has anybody seen my glasses?

Posted by: michaelmatlach | Wednesday, 02 March 2011 at 10:22 AM

I may be wrong, but if your scan is able to resolve film grain, you probably only need one bit per pixel instead of 16. There, I just saved you a computer upgrade.

Posted by: Renaud | Wednesday, 02 March 2011 at 10:34 AM

Posts like this make me glad I'm not a good enough photographer to have to worry about these things...

I use my 2800dpi scanner to make `contact sheets' from my negs, which I then print on a nothing-special Opemus enlarger. (I did recently upgrade the 5-element Meopar to a 6-element Componon-S, but that was mostly because of the extra speed, not any sharpness or resolution problems).

Glad indeed...

PS: Is there a difference between condenser and diffuser scanners? ;-)

Posted by: Bernard Scharp | Wednesday, 02 March 2011 at 11:16 AM

Stop, that way madness lies.

Posted by: Robert Roaldi | Wednesday, 02 March 2011 at 11:27 AM

Like George, I too intended to make the relevant audio comparison, but unlike George to a slightly different conclusion. once the practical limitations of the original media are met, the discussion stops in this case once the film grain is accurately resolved(data), not necessarily the supporting media. With audio, same thing once the limitation of the media is reached who cares? At that point it becomes a study and not relevant to the captured analog data.
As an archival process, digital info is weak compared to a perfect analog, but by the time I have played my original contact media, in audio's case a needle plowing through a malleable vinyl groove has the potential to be different each successive trip. The compromise with 1s and 0s may be there but the copies are less likely to be compromised.

Posted by: dale | Wednesday, 02 March 2011 at 11:31 AM

Perhaps the right answer is that photographers should emulate their painter brethren and simply *move on.* Don't keep reprinting old work and thus eliminate the need for rescanning.

Scary, perhaps unnatural, but think of the creative juices that might flow if all the old work was in the past.

--Darin

Posted by: Darin Boville | Wednesday, 02 March 2011 at 11:33 AM

Phil brings up an interesting point :-)

Ctein should approach DARPA with the proposal to build a 100,000 dpi scanner, the computer to handle the processing, and the software to display it. Then add on the possibility that there may not be drives large enought to handle even one file.

Then, after achieving this ultimate scanning goal, he is faced with scanning all his negatives.

So he takes up painting. Only one picture, no prints, and the resolution is at the maximum that is achievable for the canvas size. Consider a painting just a very long exposure.

CHEERS...Mathew

Posted by: Mathew D. Hargreaves | Wednesday, 02 March 2011 at 11:44 AM

Or, save yourself the time and effort and make prints directly from the slides/negatives — a pure analogue workflow! Failing that, perhaps send them off to be drum scanned?

Posted by: T | Wednesday, 02 March 2011 at 11:46 AM

I'm with James - I shoot a lot of B&W film, mostly 135 but a decent amount of 120 also. My scanner is a Canoscan 8400F I bought on eBay. I use Silverfast software & scan 135 at 2400dpi, 120 at 1600dpi. Those settings give me big enough files to print at normal sizes, plus I make a 1000 pixel web-sized file. And the scans happen fast, which is important to me, too.

All along, I've envisioned carving myself out a darkroom one day and doing my own 8x10s. I'll always have the negatives. If I end up with a more capable scanner one day, I'll probably go back & re-scan the best shots.

I see your point here, Ctein, when taking the time to archive, shouldn't we do it the best we can? I guess I kind of let go of that at some point.

Posted by: emptyspaces | Wednesday, 02 March 2011 at 12:10 PM

What is the purpose? Can you really tell the difference in the prints? If you can, but only in the largest-scale prints you make, why not only make 'better' scans when you need to print those particular images? "Better" is only better when you can actually realize the results. The audio 'analogy' is appropriate. Can you really see/hear the difference, or do you only think you do, because the academic bit of your brain is telling you it's there?

Posted by: CK Dexter Haven | Wednesday, 02 March 2011 at 12:28 PM

Ctein,
I feel your pain. I'm in the same boat as I too have the Minolta MultiPro... though I only moved up once from an old Nikon LS 2000 in the late 90's.
I was under the impression, from Minolta's own manual, that the MultiPro was a true 3200 ppi scanner but that interpolation in their software could provide (an interpolated) 4800 ppi scan. How are you measuring 4200 at the center and 3800 at the sides... both of which are higher than Minolta's published claims?
Much as I love the scans my MultiPro provides, I don't doubt for an instant that these could be improved with a Howtek Hi Resolve 8000 or similar drum scanner (or an Eversmart Supreme or IQ Smart 3 flatbed) but I can't justify the expense and especially the time required to become proficient at learning how to drum scan. You could have one transparency (or negative) scanned on such a scanner just to see how much you're missing. The question then becomes how much of this additional detail you'll see if and when you print these files on a cotton rag-based fine art paper? Dot gain may obscure the differences. It took me a while to come to this conclusion... but it has saved me money and envy given the limitations of my chosen substrate.
Film is frustrating in that way. Makes me all the more grateful that my hummingbird series was shot with the Leica DMR and big Leica APO glass. Film could never give me the acutance and resolution the current setup provides (not to mention the cost savings digital has provided) for this particular body of work. This is not a rant about digital being better as each medium has it's advantages and I still love shooting film.
I think José's analogy above is spot on. I'm already suffering that illness!!!
Thanks for another thought provoking post!
Lawrence

Posted by: Lawrence Beck | Wednesday, 02 March 2011 at 12:37 PM

Dear George,

You tell me!

~~~~~~

Dear José,
~~~~~~

It's not a bad analogy. A better one would be a real experience a friend of mine had. Back in the 1970s, he bought a pair of those big freestanding electrostatic speakers, the things that were state-of-the-art at the time. The difference in sound quality between those and what speakers he'd had before was palpable; none of that “golden ear” stuff. In particular, the speakers did an immensely better job of maintaining phase accuracy, which had a major affect on where you heard the spatial placement of the various instruments in the recording.

It didn't take long for him to discover that his very good turntable and cartridge couldn't quite live up to his speakers. Fortunately (or unfortunately depending on how you look at it) there were better turntables and cartridges to be had. And so, after further expenditure of money, his music listening experience got incrementally, audibly better.

That's pretty much my situation. The scans I do at any given moment are considerably better than I need and as good as I can foresee needing. Then along comes some new, unforeseen way that I want to render my photographs that's bigger, better, or simply different that exceeds the quality of those scans.

pax \ Ctein
[Please excuse any word-salad. MacSpeech in training!]
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-- Ctein's Online Gallery http://ctein.com
-- Digital Restorations http://photo-repair.com
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Posted by: ctein | Wednesday, 02 March 2011 at 12:51 PM

Dear Phil,

My physicist's mind had entertained that thought... And then ran off screaming into the dark, scannerless night.

~~~~~~

Dear James,

James meet Phil. Phil meet James.

I am sure that it is as true in marketing as an photography that when you're dealing with an elite, discerning, and demanding clientele (and that includes myself) that extra 20% or 2% or even 0.2% is what separates you from the rest of the pack. That makes the economic (as well as the artistic) rewards disproportionately large. I've made at least $30,000 over the past several years from one client because I could do film scans that were just slightly better than those of a company that charged only one third what I did. That extra 0.2% wouldn't matter to most people but it was important to them and their needs.

Your enlarger idea would work just fine except for three minor points:

1) Most of my very best prints can only be made digitally, not in the darkroom.

2) I can't make prints large enough nor on the surfaces and media I need to in the darkroom.

3) Other than the dye transfer printing, which I do strictly for the money it brings in, I have absolutely zero interest in doing further darkroom printing.

Your mileage may differ, but that's mine.

pax \ Ctein
[Please excuse any word-salad. MacSpeech in training!]
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Posted by: ctein | Wednesday, 02 March 2011 at 01:04 PM

If you think that the details of each individual grain are important components of your image, then indeed, you need enough resolution to simply resolve each grain. If, on the other hand (and I think this is what you're saying, Ctein) grain merely carries certain high-frequency information which is important to the image, then you can probably get away with much lower final resolution. Here's how:

- evaluate the frequency of that important information, and double it per Nyquist and probably add a bit for fun to get your target final resolution.
- reconstruct your image at infinite resolution, utilizing all the information in the grain (in practical terms you reconstruct at some modest multiple of that, say 5-10x or so), then low-pass/anti-alias filter that to the target peak frequency, and resample to the final resolution. You've moved all the information from the haphazard arrangement of grains into a neat rectilinear grid, but it's all still there.

Voila, your film grain is gone, but your image is there at the maximum necessary resolution.

Assuming that the anti-aliasing built in to the scanner is lousy to non-existent (which, I don't know, is it? Do they filter, or do they just sample values at each dot?) you can simply take multiple scans of the same negative and apply supersampling techniques. You can probably do this in a tiled fashion, so you needn't reconstruct the entire image at 48,000 dpi or whatever.
~~~~~~

The down side is you'll need a lot of scans of each negative, all slightly different. You might be able to simply pat the scanner between scans, though, since we're looking for sub-pixel differences.

This is pretty much the same problem as your tablet based "view camera" it turns out.

Posted by: Andrew Molitor | Wednesday, 02 March 2011 at 01:06 PM

If you want to know by experiment what would be "good enough" now, rather than when you have a 19200ppi scanner available, you might "scan" small parts of images using a microscope with an attached camera.

Posted by: Peter Morgan | Wednesday, 02 March 2011 at 01:32 PM

Phil,

It just got worse - 50nm - see:

http://www.bbc.co.uk/news/science-environment-12612209

Posted by: Graham Wood | Wednesday, 02 March 2011 at 01:45 PM

Dear Ctein,

Have you experimented with using a microscope with a DSLR attached to see how much could potentially be resolved? Aside from the tedium of stitching, I suppose there are other disadvantages, such as captured bit depth.

Will

Posted by: Will Frostmill | Wednesday, 02 March 2011 at 03:03 PM

Hmmm, this reminded me of the endless arguments of analog vs digital.

One common error that a lot of folks make is to confuse grain in analog with pixels in digital. Grain is NOT the limit of resolution in film. A few well known sites claim it is. Sorry, they are wrong. I can go into details but not in this media.

And many confuse scan alias noise with film grain, a common event in many sites "explaining" why "digital is better".

Dont'get me wrong: the advantages of digital capture are many, but most have nothing to do with the resolution itself.

As Ctein is finding out, one man's measure of success is another's measure of failure.

I started out my 35mm scans at 1200 on a flatbed. Now I go as high as 4000 for MF on a Coolscan 9000 and still not get all I can see with a microscope.

But it's almost there. Enough to keep me happy, anyway.
Until something better comes along. Be very afraid indeed!

Posted by: Noons | Wednesday, 02 March 2011 at 03:15 PM

The latest medium format digital backs are approaching 100Mpixels (currently at 80) - could you not use one of these as a tool, with a good shorter focal length specialist macro lens, to invesigate the required scanner resolution for good grain imaging, by looking only at part of the film image? If, for some reason, it really should be a scanner, why not do the same thing with a scanning camera - eg last generation Leaf) If workable, would seem much easier than waiting for the next generation of scanner. This also leads on to the question of when (which coming generation of cameras, which are evolving far faster than scanners) it will be more effective to digitally photograph your film with a good digital camera and lens, rather than scan?

Posted by: Danny | Wednesday, 02 March 2011 at 04:33 PM

Ctein, The last 10 years of my B&W work, I only processed film in Pyro developer. Beautiful hi lites and shadows and since the resulting D Max was very low - they scan beautifully.
I assume you are using some type of oil immersion system to scan with. It's really the only way you will get full resolution out of a negative.
I worked with Don Browning on a few projects back in the 60's, unrelated to his dye transfer but learned how he got 35mm to look like 2 1/4 Oil immersion & point light source. Beautiful stuff.
With out oil immersion I don't think any scanner is up to the task, just like in the dark room. That's how Kodak did their supposed display C prints for camera stores way back in the 'early 60s they were really dye transfers.

Posted by: Carl L | Wednesday, 02 March 2011 at 05:21 PM

Back when I was a member of the IEEE, there was an article in one of their journals about how Turner digitized and then colorized films. One of the criteria settled upon was the duplication of grain structure from the original negatives of the movie, as Turner's technical people knew that they were going to have only one go at actually digitizing that much film.

After much experimentation and money was spent, they went to the NSA to talk about how they managed large data sets. The NSA smiled, patted them on the head, and told them that they'd be best off scanning at 4k pixels for the long side of the frame, as scanning at higher resolutions did not increase the signal-to-noise ratio. Further, it was the resolution that made sense it terms of being able to scan at a reasonable rate.

This has been, as far as I know, the standard for digital motion picture work ever since. 4k cameras are out there (Arriflex, Red) as the human eye cannot perceive the difference between anything captured on film or on digital cameras at that level in a standard movie theater. There are differences, but the differences are largely technical.

Given the size of 35mm motion picture film (24x18), you can do the math: 4000/24 is the resolution that provides the greatest detail with the minimum file size. That's what, ca 80 line pairs/mm? Or 160 lines per mm resolution?

Like I said, that is from memory of what Turner did when they digitized so many films. There was, of course, a 100GB+ buffer involved to handle the data stream...

Posted by: John F. Opie | Wednesday, 02 March 2011 at 05:32 PM

From PAL to HD we can see the fault to use digital camera to take even TV series. But gone with the wing etc. is ok! Some of the best TV series just lost the appeal when seeing in my "small" 42"screen (the "small"is according to many TV review sites and I found it strange to call this "small" but once you got one, you found that it is "small" when seeing blu ray disc!). You need to do a high resolution for give future a little proof. Use film.

On the other hand, using digital especially live view you can resolve a lot of issues of (landscape/macro) photograph which unless you are in 8x10 sometimes the camera system get you. After going through the whole process of snapshot using Nex3/D300/iphone, then bring the 4x5 camera to the scene, taking photo and then it fails to focus completely on the subject etc., you are very unhappy. But if you got it, it is more future proof. Digital has its advantage but got you fixed on the resolution.

Dilemma still for the state of this hobby. (For professional, digital can you more turn around and probably not a choice. For artist, ...)

BTW, Minolta is said to be better than Nikon 9000, as one use diffuse light and the other use hard / "condenser" light. Sold my Nikon V as I do not like its grain. I assume Nikon 9000 is the same. But cannot find any more Minolta for medium format scan.

Posted by: Dennis Ng | Wednesday, 02 March 2011 at 05:49 PM

Why not just scan for 'reasonable' print sizes (the web, and whatever the scanner you can afford can output. LIke for me, my Epson V700 scans from 6x6 yields a pretty good 13x13 inch print), and then only in those rare instances when you need to go big, either have made or make yourself a truly detailed reproduction?

This kind of thinking is exactly "How I stopped worrying and learned to love Tri-X."

Posted by: Mark Sperry | Wednesday, 02 March 2011 at 07:13 PM

For scanning film, I would venture that there is really only one good subjective way to decide if the scans are as good as you need them to be.

You need to ask yourself, can you make a print from the scans that you like at least as much as the print you can make from the original negative? Following from that, would you actually be happier with a print made from a higher-resolution scan?

Sometimes I feel that it is too easy to worry about whatever technical limits there are to our photography, and temporarily forget that the main thing is whether or not we are happy with the quality of our work and the progression in our art and skill.

Posted by: NF | Wednesday, 02 March 2011 at 08:10 PM

Basically, I agree with NF's statement that,

You need to ask yourself, can you make a print from the scans that you like at least as much as the print you can make from the original negative? Following from that, would you actually be happier with a print made from a higher-resolution scan...Sometimes I feel that it is too easy to worry about whatever technical limits there are to our photography, and temporarily forget that the main thing is whether or not we are happy with the quality of our work and the progression in our art and skill.

In 1997, I corresponded with the late Bruce Fraser on these issues. He wrote,

4800 dpi will probably resolve grain in 800 ASA film, but with slower-speed films the scans pick up the interference pattern between the scanner's sampling grid and the film grain rather than the actual grain stucture....As to how significant this is, that's a tough question. We usually want to reproduce the image, not the grain structure. If you resolve individual grains, you can be certain you've picked up every last iota of detail, but it's probably overkill. That said, I've seen various arguments suggesting that this or that resolution is enough to extract all detail, and I've never found any of them persuasive.
...It's almost impossible to reproduce the grain structure of a specific film stock digitally...

—Mitch/Bangkok

Posted by: Mitch Alland | Wednesday, 02 March 2011 at 08:56 PM

Hopefully someone will start hot-rodding these scanners, putting better lenses and software in them like they did and might still do with old AR turntables. Or maybe at some point something like the Imacon will yield better results than my trusty Epson (hasn't happened yet, but no reason it can't)
But the question remains, why scan for archives when the technology is fluid?
I called up the L O C a few years back to ask how to preserve my old 16mm films in the new digital world. They said preserve the film, it will outlast any current digital format.

Posted by: Doug C | Wednesday, 02 March 2011 at 09:13 PM

As far as using a microscope goes, as long as were talking theoreticals, you could probably do X-ray scans down to 10 nm or so. Or why not use a SEM or TEM too actually image the physiical 3-D structure of the film?

Posted by: David Bostedo | Wednesday, 02 March 2011 at 09:16 PM

Dear folks,

Quite a few commenters have raised questions about my needs and motivations for doing this level of scanning. I addressed those matters in the comments I linked to in the very first paragraph of this column. When I include a link to previous writings of mine, it's because there's material there that is germane. Please familiarize yourself with it before commenting; it may save you some effort.

There's an interesting misconception evident in some of the comments, which I hadn't realized some people might have: that it's considerably more work on my part to do a very high resolution scan than a low-resolution one. In fact, that has little effect on my labors. The retrieving and refiling of negatives, film preparation and cleanup, and scanner preparation and set-up all take about the same amount of time regardless of the resolution I'm scanning at. The scanner has to grind away longer for higher resolution scans, so throughput as measured by the clock is substantially worse. But I don't have to babysit the scanner while it's doing it's business. I'm off taking care of mine, and it doesn't much matter to me if the scanner takes 10 min. or 40 min. Consequently, there's little benefit to me to making a lower quality scan now if it makes it more likely that I'm just going to have to go make a better scan sooner rather than later.

Now, working with a very large scan is definitely a lot more time-consuming, no question of that! But I only need to work with a large scan when I need the large-scan quality. If I'm doing something like preparing an image for the web, rest assured I'm going to be resampling that file way down before I start messing with it.

pax \ Ctein
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-- Ctein's Online Gallery http://ctein.com
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Posted by: ctein | Wednesday, 02 March 2011 at 09:45 PM

I was reminded of a vintage movie while reading this article.

"Dr. Strangelove or: How I Learned to Stop Worrying and Love the Bomb"

You know - Peter Sellers, and his rogue right hand and concomitant vocal eructations....

Only it goes something like this:

"MEIN PIXEL PEEP!!!"

(*Ctein grabs right hand and wrestles it down*)

pax / Old Fart

Posted by: Old Fart | Wednesday, 02 March 2011 at 10:25 PM

I'm surprised that no one has brought up what I consider to be the most interesting point here - namely that scanning at higher and higher resolutions is just beginning to show us how incredibly GOOD an expertly focused, exposed, and printed analog photograph is. We've all been saying for years that there's something special about an original darkroom print; I suspect that at least part of the "specialness" resides down in the individual grains, which even now we can't resolve, much less duplicate, on a digital sensor (by the way, I don't think it's just the size - the geometry of the grains, which aren't arranged in a rectilinear way, buys you something too).

I'm whispering a little prayer of thanks to the wizards at Kodak and elsewhere for the magic they sweated so hard for so long to put into our film cameras.

Posted by: Bob Blakley | Thursday, 03 March 2011 at 12:03 AM

It's not strange if you have a print shop background and know the difference between ordinary print screens and stochastic screening. Pixels are of the same form, size and with the same distance in between them. Grains however varies in size, form and distance. It's two different beasts.

Posted by: Jörgen Persson | Thursday, 03 March 2011 at 02:39 AM

Ctein,

Since the structures you're trying to image are so small, it seems to me that they would not have any particular individuality outside an ability to add a certain...mmm, cut, or possibly buzz...to your prints. If that is true, why not just artificially create an incredibly fine grid to provide that quality, and then merge it with your best-quality image. The original would give you the structure, the grid would give you the undefinable buzz.

JC

Posted by: John Camp | Thursday, 03 March 2011 at 04:14 AM

Regarding those little square pixel-sized blobs, did you ever read Alvy Ray Smith's seminal paper refuting this misconception?
http://alvyray.com/memos/6_pixel.pdf

Posted by: Christopher Jones | Thursday, 03 March 2011 at 06:25 AM

Ctein, I feel your pain. I've kept a Minolta DSE 5400 (I) even after I bought a Nikon 9000. The Minolta does a better job on Kodachrome, in no small part becuse of its increased resolution (5400 vs 4000 ppi)
Comparison here:
http://1.bp.blogspot.com/_MuCFC81kV70/TH8PrahinnI/AAAAA

Posted by: Tom | Thursday, 03 March 2011 at 07:09 AM

Dennis, the light source of the 9000 is not a condenser light and does not cause the problems you get with the V, 5000, 4000, IV and 8000. The "hard light" of the 9000 is a myth propagated by those who have never used one. And NO, the 8000 is NOT the same! I have used both and there is a world of difference.

Posted by: Noons | Thursday, 03 March 2011 at 08:36 AM

Ctein,

Greetings. I'm sorry to say that of course you will want to do this again in five years. The good news is that the 10 GB or so image size won't seem that large in your petabyte storage system. Okay, maybe a little longer than 5 years but you catch my drift.

I think really what you're about when you say "so good that I could never imagine needing better ones" is the ability to reconstruct those negatives. There isn't any reason to think that this won't be possible in the not too distant future.

Certainly there is technology in a collective sense today to near perfectly reproduce a negative. It's a simple matter of cost. Think scanning electron microscopes (both for imagery and molecular manipulation), if you must. I would think there is enough motivation for preservation of images in the grand scheme of things to reasonably expect what you want at a price within reach.

So now the question is when. I'd wager within 15 years (10 more cycles of Moore's Law). We may be able to see the trajectory in half that time. You might consider waiting for it.

Cheers,

-Yamo-

Posted by: Michael Gerald-Yamasaki | Thursday, 03 March 2011 at 08:44 AM

Erwin Puts has an article that is relevant to the technical issues in extracting the maximum information down to grain level:
http://www.imx.nl/photo/Film/Film/Film/page39.html
In particular, he points out that the grain patterns are the result of the overlap of grains at different levels in the emulsion layer.

It seems to me that even with a microscope you have a fundamental limitation related to the diffraction limit: if you want to image the details of the grains, you need an objective with high numerical aperture (very low f-number) but then your depth of focus will be shallower than the thickness of the emulsion layer.

Posted by: JPC | Thursday, 03 March 2011 at 11:44 AM

I have my Nikon film cameras gathering dust
displayed on my bookcase shelves. I stopped
shooting film many,many years ago and went
to digital 100%. Articles like this fortify
my decision as correct.

Posted by: paul logins | Thursday, 03 March 2011 at 01:29 PM

Dear Doug,

This isn't about archiving, this is about use. I'm forced to make better scans every five years because I NEED the higher quality. Every time I think I've gone as far as I could possibly need to go, something comes along that demands better. My track record so far is zero for three. This does not give me huge confidence that the fourth time will be the charm.

My negatives are all in the deep freeze. Assuming someone cares enough to pay the electric bills, they will be usable for another century. At least. Having the original negatives isn't the issue, having to go back and work with them again and again is.

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Dear David and others,

There are many schemes I could use to investigate the detailed structure of silver grains and dye clouds, but most of what people are suggesting doesn't tell me what they LOOK like. Deriving that from submicroscopic examinations is still an intractable problem. To know what they're going to look like when you use them in practice you still pretty much have to illuminate them with the kind of light you're going to be using to print or scan them, and just use really high-resolution optics or scanners.

In any case, from ancillary work I am pretty well convinced there is worthwhile image information still to be extracted, in principle. What I'm hoping is that in practice I will never actually NEED that information. But as I just said to Doug, my track record on predicting this is not exactly exemplary.

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Dear JC,

That would work if the problem were only one of emulating the appearance of grain. In fact there are some pretty nice software packages out there that do an excellent job of re-creating the look of classic films.

The real problem is that the actual grain structure contains meaningful photographic information. So it's not sufficient that I fake it; should I ever need that exquisite level of information, I'll actually have to go in and dig it out.

I'm still hoping that won't come to pass, being the ever eternal optimist.

pax \ Ctein
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Posted by: ctein | Thursday, 03 March 2011 at 02:42 PM

I managed to make a pretty careful comparison test, scanning a grainy 35mm ISO 800 Tri-X negative at 3200, 4000, 6300, and 8000 dpi.

The image content (not grain) could be fully resolved at relatively low scan resolution. These tests were about the grain instead.

I used an Imacon with auto-sharpening disabled, plus a Leafscan 35(!) for the 4000dpi scan, again with no sharpening. I carefully matched tonality, and then upsampled all images to 8000 dpi for comparison.

The results were interesting. It was possible to resolve the grain sufficiently to avoid aliasing artifacts by scanning at 6300 dpi or above. 8000 dpi offered almost no further benefit. Below 6300, the grain looked "digitized" due to aliasing.

I had an optical print made for reference as well. These differences were definitely visible at 20x24, and somewhat visible below that. Granted, these are very large prints for 35mm.

BTW I also tried a Kodacolor 800 color negative, to see if it behaved differently. I found that the softer dye clouds would not cause artifacts as easily and could be scanned confidently at just 3200 dpi. Note: I didn't try a negative with open blue sky which might be a tougher case, but I was pretty convinced. Besides, such sky areas can easily be cleaned up in post production.

This is not to say that high resolution, low speed films would behave the same way. I was only concerned with high speed films.

Posted by: Charles Rozier | Friday, 04 March 2011 at 09:03 AM

Dear Charles,

Thanks for taking the trouble to do that.

Paraphrasing your results, sound like 4000 to 6300 produces subtantial changes, while 6300 to 8000 only produces slight changes. So, depending on whether the curve has actually bottomed out, somewhere between 8K and 12K PPI might be the max that ever could matter.

With one important question unanswered-- what did you find the actual resolutions of your scanners to be, as opposed to the scan pitch? That's critical; without the information, the fact that there's only a slight difference between 6300 and 8000 ppi scans could just as easily be because there's only a slight difference in the scanner's real resolution.

That's not to say your results aren't extremely useful for you -- you now have a good idea of just what your scanner can extract from your film. Very practical! I'm just trying to figure out if I can glean anything useful for me.

pax / Ctein

Posted by: ctein | Friday, 04 March 2011 at 10:54 AM

Re optical resolution, I don't know what the actual numbers were. But FWIW the Leaf used a highly regarded Rodenstock 80mm enlarging lens, and I don't know what was in the Imacon. All I can say is that the scanners were both in a category ordinarily considered optically excellent.

I tried sharpening the files to the point that they were as similar as possible to a reference optical print. This was a while ago so I'm going from memory, but my recollection is that regardless of the variations in overall sharpening, one could see artifacts (blocky looking grain) in the scans below 6300, and not in the ones above. The difference between 6300 and 8000 dpi was hard-to-impossible for me to see.

It was also interesting how much the Leaf scan resembled the Imacon scans, showing a degree of resolution very much in line with its 4000dpi spec, no more and no less. In other words, the scanner brand and mechanical design didn't seem to matter much, and the resolution of both scanners seemed to be limited by the sensor pitch, at least up to 6300 dpi. I don't know whether the 8000 dpi result was a consequence of the lens running out of resolution above 6300, or the actual film grain edges being of finite sharpness. I wouldn't be surprised if it was the latter, or a bit of both.

I can't say, of course, how these results would apply to you, since you probably used film with very different resolution-to-grain (or signal to noise) ratios, and smaller grain, than I did.

Posted by: Charles Rozier | Friday, 04 March 2011 at 03:09 PM

"The problem is that I'm pretty sure these aren't the best of all possible scans."

Of course not. Prosumer Minoltas and Nikons are not Flextights or drum scanners. Minoltas and Nikons are limited, but it ain't the pixel size that's the limitation, nor are the higher available PPI capabilities the main reason why the expensive solutions look better.

Posted by: David | Friday, 04 March 2011 at 09:35 PM

Dear Charles,

The similarity of the two scanners' results does argue for the robustness of your results. Much appreciated.

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Dear David,

Data is not information. The question of interest is not whether one scanner can collect more pixels than another, it is whether it is acquiring additional useful information. I'd say yes, but if someone had come up with convincing evidence that 4800 ppi got you everything that mattered, well that'd be it.

Pax / Ctein

Posted by: Ctein | Friday, 04 March 2011 at 11:31 PM

The simplest low cost way to go beyond current scanners is to attach your digital camera to a microscope. 20x should clearly define the grains. Any modern stitching software can quickly put it back together.

Posted by: Arthur | Saturday, 05 March 2011 at 01:16 PM

The comments to this entry are closed.
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