Subject: Re: Determing true resolution of an image?
Posted by chrisduckworth on Mon, 11 Mar 2002 04:21:29 GMT
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On 8 Mar 2002 08:19:50 -0800, weitkamp@esrf.fr (Timm Weitkamp) wrote:

> chrisduckworth@hotmail.com (cnd) wrote in message
news:<3c8856d3.58341995@news.mem.bellsouth.net>...
>
>> [...]
>> It sounds like you want to do an MTF (modulation transfer function)
>> measurment. This is a some what common measurment. If I rember my DSP,
>> you need to scan the analog image at a rate of 2.15 times the analog
>> nyquest.
>> But, umm, this is probably the wrong news group for this stuff.
>
> Well, be that latter point as it may. Chris, do you have a good
> textbook or tutorial reference for this stuff at hand? I happen to be
> concerned with this kind of problem but find it hard to get hold of
> efficient learning material on DSP fundamentals such as sampling
> issues (that 2.15 is not really intuitive).
>

First the 2.15: The 2 comes from the nyquest sampling theorm. When digitizing a set of analog data, the sampling frequency must be greater (not equal to) 2 times the highest frequency component of the analog input signal, or else you get aliasing. On most systems your sampling frequancy is not variable so you pre-filter the analog signal to insure that you don't get aliasing. But if you use a sharp cutoff filter, you will induce a ringing artifact in the digital data Thus, you use a filter that curves at the ends (like a fermi function), and you add a little more to the sampling frequancy (I think that is called the Keller factor). the choice of .15 for this factor is somewhat arbitrary, but .15 is typical.

Now MTF: Sorry, I don't have a good tutorial for this stuff at hand. For books, the SPIE has several and the best choice depends on the type of application. In medical imaging I would recommened their medical imaging handbook.

Measuring MTF: In most systems there is only two ways of measuring MTF, via slit or edge. There is also a CTF (contrast transfer function) that can be approximated to an MTF. The slit method is most precise, but it is very tedious. the edge method is noisy at low frequancies. The CTF always over-estimates the MTF.

For the slit measurment, you have a slit in the image of a known apreture and you take a series of images with varying apretures. That

series of images is your line spread function data set.

For the edge measurment, align a sharp edge in the image. Take the derivative of the data going across the edge and you have an lsf.

For the CTF, use a bar pattern, which is a series of light and dark bars in an image. The light and dark bars must have the same width and twice that width is the apreture of that measurment. Typically, there are several groups of bar patterns within a single image, or some variation like a star pattern. Also, CTF is usually reported in line pairs per mm (or cm) and MTF is reported in cycles per mm (or cm).

Sorry my description is so brief. There is plenty of litreature on this stuff in SPIE books and journal articles. All MTF (lsf based) measurments that I know of are founded in the above three methods. For a typical field of view there are some 30 diffrent MTF's that can be measured.

Thanks,
Chris Duckworth
