

Re: Increase depth of field without reducing aperture?

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Source: <http://sci.tech-archive.net/Archive/sci.optics/2005-11/msg00056.html>

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 - *Date:* Mon, 07 Nov 2005 11:26:04 -0500
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John Devereux wrote:

Hi,

Is it possible to increase the "depth of field" of an imaging system without reducing the aperture?

My understanding is that if I use a pinhole, the depth of field is infinite. But hardly any light is collected. As the aperture is increased, the image becomes more and more blurred except for objects in a narrow range of distances from the objective.

Is there a way around this?

Apologies for the imprecise terminology!

There is a direct tradeoff between resolution and numerical aperture in any linear imaging system: the focused spot size goes as λ/NA , and the DOF goes as λ/NA^2 until you get to near $NA=1$, where it gets a bit more complicated. Thus for a fixed resolution, you can get more DOF by decreasing both the NA and wavelength such that λ/NA is constant.

On the other hand, if what you are actually looking for is sharper pictures of a particular scene, there are lots of hook-or-crook methods to get better results. The traditional one is tilting the film plane with respect to the lens, to obey the Scheimpflug condition, which states that the object and image planes meet in a line lying in the plane of the centre of the lens. Thus by tilting the film as in a view camera, you can

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tilt the plane of best focus to match the arrangement of the scene.

There are also modern nonlinear tricks, e.g. using a confocal microscope and summing images taken at different depths; the out-of-focus energy doesn't make it through the pinhole on the way back, so to some approximation, only the sharp parts of the images survive the operation.

Some digital cameras can do a poor-man's version of this too, I think--but the image combining is a bit of image-processing smoke and mirrors rather than something simple and physical like summation.

Cheers,

Phil Hobbs