How to...

Get the Optimal Resolution from your CCD Camera

It is important to determine the minimum required resolution for your CCD camera in order to provide the maximum spatial image resolution. According to Abbe's equation (1), the minimum object resolution can be calculated with:

$d = \lambda/2*A$ **(1)**

d = shortest resolvable distance between two points
λ = wave length of light
A = numerical aperture of used objective

The distance of two resolvable points in the intermediate image plane can be calculated with (2).

$D = d*Mobj.$ **(2)**

Mobj.= magnification of the objective

There is no spatial image information between these two points. According to Nyquist, each pair of lines has to be scanned with two pixels in order to achieve maximum spatial camera resolution. The necessary number of pixel per mm can be calculated as shown in (3).

$R = 2/D$ [pixel/mm] **(3)**

One can now calculate the necessary camera resolution in x & y directions using these formulas: (4) & (5)

$R(x) = N*A/Mobj. * X/Tv$ **(4)**
$R(y) = N*A/Mobj. * Y/Tv$ **(5)**

N = 4000/λ[µm]
A = num. aperture of objective
Mobj.= magnification of objective
X = chip size in x direction [mm]
Y = chip size in y direction [mm]
Tv = reduction factor of coupling camera adapter

Examples:

Using a Zeiss Plan -Neofluar 5x/0.15 (mag. of 5, numerical aperture of 0.15), and a camera adapter of Tv=0.63, the necessary camera resolution for a 2/3" (8.5x6.4mm) chip is approx. 2700 x 2030 pixel (wavelength 0.6µm). A camera adapter with no reduction Tv=1 would require camera resolution of 1700x1280 pixel. Likewise, a 100x/1.4 Plan Achromat Tv=0.63 would only require 760x570 pixel for maximum spatial resolution.

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