LENS EXTENSION

For a very distant object (“at infinity”), the sensor has to be placed in the focal plane of the lens, i.e. a’ = f. To focus a nearer object, the distance between lens and sensor has to be increased by using a lens extension

$$\Delta s' = f \cdot \beta$$

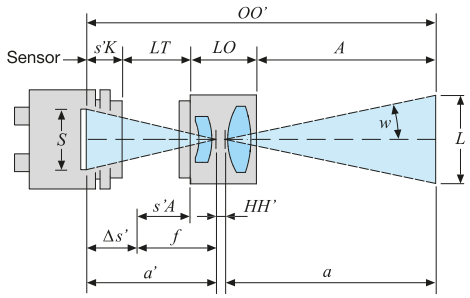
For C-Mount and Photo lenses, the lens extension is achieved by using their internal focusing mechanism, up to a specified minimum object distance. Extension rings are available for C-Mount lenses to increase the extension further and to focus nearer objects. This a convenient solution but might impair imaging quality. For scan and macro lenses, the solution is more complicated. The required tube length LT needs to be calculated from the lens extension and the formula on tube length and implemented using extension rings and a focus adapter.

EXAMPLE 1

Magnification β = 0.099
Focal length f = 50 mm
Lens extension Δs’ = 50 mm x 0.099 = 4.95 mm

EXAMPLE 2

In macro imaging with β = 1 (1:1 imaging), the lens extension equals the focal length f.



Lens parameters scheme

IMAGING PARAMETERS

Schematic depiction of the imaging system and definition of variables used.

f = Lens focal length (mm)
S = Sensor length (mm)
L = Length of Region of Interest (ROI) of object (mm)
a = Object range (mm)
a’ = Image distance: Distance from sensor to HH’ (mm)
β = Magnification
w = Field angle
OO’ = Distance from sensor to measured zone (mm)
s’A = Flange focal length (mm)
Δs’ = Lens extension (mm)
LT = Tube length
A = Working distance (mm)
HH’ = Principal point distance (mm) (can lengthen or shorten OO’)
s’K = Camera flange length consisting of focus adapter series FA22 and extension rings series ZR (mm)
LO = Lens length (mm)

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