5X Keplerian - Vignetting/Telecentric

$f_{obj} = 200mm$ $\quad \phi_{obj} = .005$

a) Telescope Design $\quad MP = -5 = -\frac{f_{obj}}{f_{eye}} \quad f_{eye} = 40\,mm$

$$L = f_{obj} + f_{eye} = 240\,mm$$

$D_{obj} = D_{stop} = 40mm$

$FOV = \pm 2° \quad \bar{u} = \tan 2° = .0349$

Trace marginal and chief rays to the eye lens:

$u = 0$

$y_1 = D_{obj}/2 = 20$

$u' = u - y_1 \phi_1 = -0.1$

$y_2 = y_1 + u' L = -4.0\,mm$

$\bar{u} = \bar{u}' = .0349$

$\bar{y}_1 = 0$

$\bar{y}_2 = \bar{u}' L = 8.38\,mm$

Unvignetted at eye lens: $\quad a_{eye} \geq |y_2| + |\bar{y}_2|$

$a_{eye} \geq 12.38\,mm$

$D_{eye} \geq 24.76\,mm$

b) For the system to be doubly telecentric, the stop is located at the common focal point of the telescope.

- Stop 200 mm behind the objective lens.

c) Imaging — Δz from F of objective

$\Delta z'$ from F' of eye lens

$$\bar{m} = \frac{\Delta z'}{\Delta z} = m^2 = \frac{1}{M_P^2} = \frac{1}{25}$$

Object at 400 mm $\Delta z = -200$ mm from F_{obj}

$\Delta z' = -8$ mm from F'_{eye}

Image: 32mm to the right of the eye lens

Object at 100 mm $\Delta z = 100$ mm from F_{obj}

$\Delta z' = 4$ mm from F'_{eye}

Image: 44 mm to the right of the eye lens