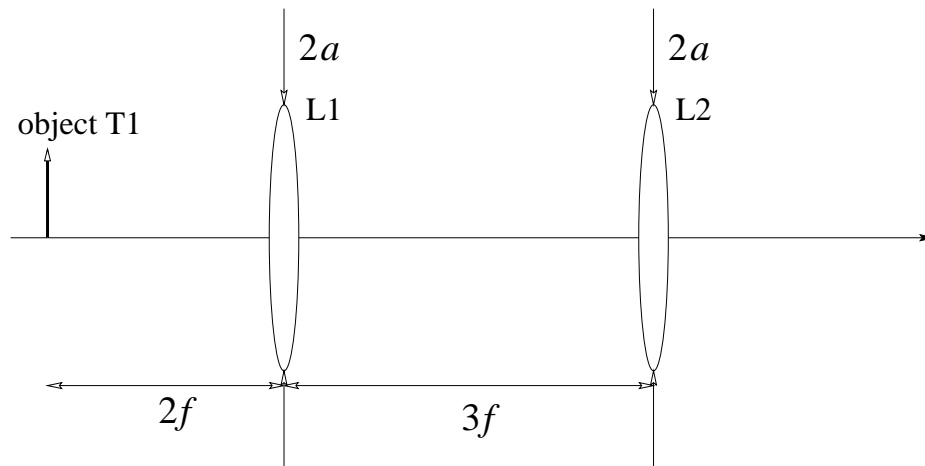


1. Goodman problem 5-8 (page 122). *Hint* : Use the result from Goodman figure 5.12, and the discussion after equation 5-57.
2. Goodman problem 5-10 (page 123).
3. Consider the optical system shown below, where lenses L1, L2 are identical with focal length f and half-aperture a . A thin-transparency object is placed $2f$ to left of L1.

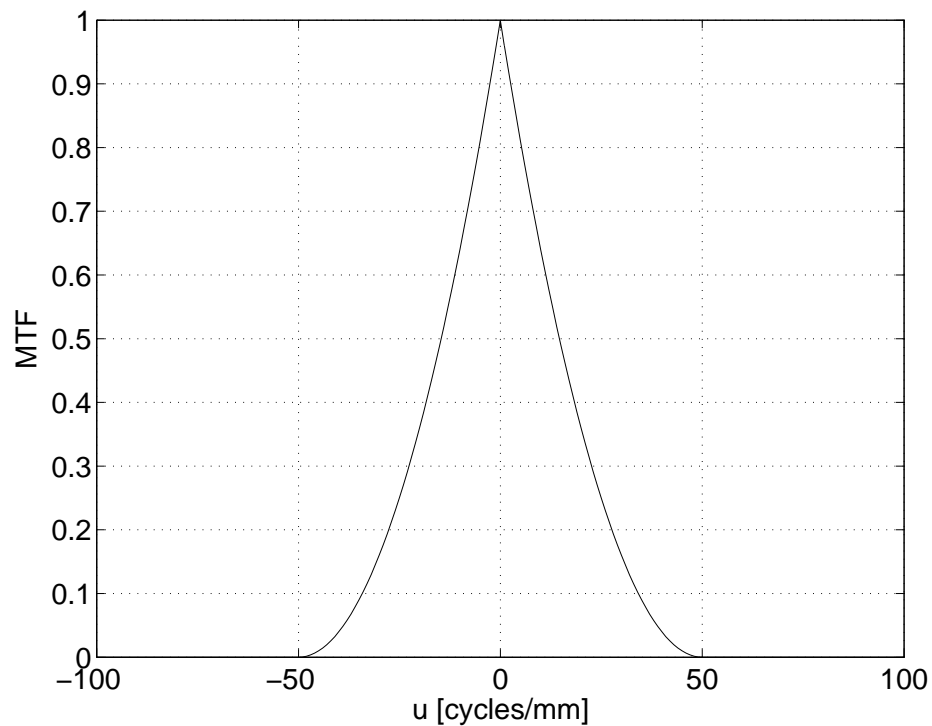


- 3.a) Where is the image formed? Use geometrical optics, ignoring the lens apertures for the moment.
- 3.b) If the object T1 is an on-axis point source, describe the Fraunhofer diffraction pattern of the field to the left of L2.
- 3.c) How are your two previous answers consistent within the approximations of paraxial geometrical and wave optics.
- 3.d) The point source object T1 is replaced by a clear aperture of full width w and a second thin transparency T2 is placed between the two lenses, at distance f to the left of L2. The system is illuminated coherently with a monochromatic on-axis plane wave at wavelength λ . Write an expression for the field at distance $2f$ to the right of L2 and interpret the expression that you found.
- 3.e) Derive and approximately sketch, with as much quantitative detail as you

can, the intensity observed at distance $2f$ to the right of L2 when T2 is an infinite sinusoidal amplitude grating of period Λ , such that $\Lambda \ll a$

4. Goodman problem 6-11 (page 169)
5. The modulation transfer function (MTF) of an optical system is given in the figure below. The system is illuminated with quasi-monochromatic, spatially incoherent light. The intensity pattern at the input plane of the system is given by

$$I(x) = \frac{1}{2} \left[1 + \frac{1}{2} \cos \left(2\pi \frac{x}{40\mu\text{m}} \right) + \frac{1}{2} \cos \left(2\pi \frac{3x}{40\mu\text{m}} \right) \right]$$



- 5.a) What is the contrast of the original intensity image?
- 5.b) Plot the intensity pattern formed at the output plane, and calculate the image contrast.
- 5.c) Can you guess the coherent transfer function and cut-off spatial frequency for this imaging system?