FIGURE 8.6 Simplified resolution/field of view (FOV) calculation

From Figure 8.6 the relationship between scene resolution, object distance, focal length, and interpixel spacing at the sensor central region may be simply quantified by

$$R_f(z_o) = (z_o/f_f) (f_f)$$  (8-2)

where $R_f$ is the discernable scene dimension, $z_o/f_f$ is the magnification ratio, and $f_f$ is the interpixel spacing.

For example, given the following parameters for a sensor for a satellite-based remote sensing system:

- Typical perigee of satellite = 275 km (170 miles).
- (equivalent) focal length of imaging system = 1 meter (m).
- Minimum required ground resolution = $2m$.

The required CCD sensor interpixel spacing is determined using Eq. 8-2, to be $7.3 \mu m$. From this specification, the sensor might discern the presence of individuals, but objects they might be holding or their faces would not be discernable.
\[ P \text{ (INTER PIXEL SPACING)} = \frac{R_0 \cdot f^2}{\frac{z_0}{R_0}} \]

**GIVEN**
\[ R_0 = 2 \text{ m} \] (assumed)
\[ f = 1 \text{ m} \]
\[ \frac{z_0}{R_0} = 275 \text{ km} \] (170 miles)

\[ P = \frac{(2 \text{ m})(1 \text{ m})}{275 \times 10^3 \text{ m}} = 7.27 \times 10^{-6} \text{ m} = 7.27 \text{ mm} \]

- **Human Eye Resolution** \( \approx \frac{1}{60} \text{ degree of Spatial Resolution} \)

**Modulation Transfer Function (MTF)**

\[ \text{MTF} = \frac{\sin(\pi f \delta x)}{\pi f \delta x} \]

Indicates loss or "Roll Off" of sensor frequency response due to spatial (not continuous) integration. Ideally \( \delta x = 0 \); hence, MTF = 1.