In this simple imaging geometry, a detector element of area $a$ forms an image on the ground, with a ground pixel area

$$A = H^2 a / f^2.$$ 

The linear dimension of the ground pixel ($B = \sqrt{A}$) determines the ground resolution achievable by the imaging instrument. There are several ways to improve the ground resolution (i.e. to decrease $B$):

- Fly the satellite at a lower altitude (decrease $H$);
- Use a smaller sensor element (decrease $a$);
- Use a longer focal length for the telescope (increase $f$).

As we will be seeing later, decreasing $a$ and increasing $f$ will result in a decreased signal strength. The detected signal level needs to be several times larger than the inherent noise level of the detector in order to be useful. Sensor manufacturing technology also imposes a minimum
achievable. Increasing $f$ will increase the size of the instrument, which may be constrained by the available space in the satellite payload bay. There is also a limit on how low a satellite can fly, due to the effects of atmospheric drag.

Suppose that the ground leaving radiance is $L_0$. The optical axis is oriented along the vertical direction. The flux from the ground pixel area reaching the telescope aperture (neglecting effects of the atmosphere) is

$$\Phi = L_0 A \Omega, \quad \Omega = \frac{\pi D^2}{4 H^2}$$

where $\Omega$ is the solid angle subtended by the aperture on the ground. Assuming a lossless optical system, this flux is transported to the detector element. If the effective exposure time for the pixel is $t$, the radiant energy received by the detector element is

$$Q = \Phi t = L_0 \frac{H^2 a \pi D^2}{f^2 4 H^2} t = \frac{\pi D^2 a}{4 f^2} L_0 t.$$  

From this equation, it is seen that there are several ways to increase the signal level:

- Use a large detector (increase $a$);
- Use a large aperture telescope (increase $D$);
- Use a short focal length imaging optics (decrease $f$);
- Increase the exposure time (increase $t$).

Each of these steps will affect the performance in other aspects. Increasing $a$ and decreasing $f$ will increase the ground pixel size, resulting in a poorer ground resolution. The exposure time is limited by the motion of the satellite in orbit. Increasing the aperture will increase the collection area, but it will also add to the weight of the instrument to be carried by the spacecraft.