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TECHNOLOGY CHALLENGES OF VERY HIGH RESOLUTION IMAGING FROM A SMALL SATELLITE MISSION

Abstract

Traditionally Very-High Resolution (VHR) optical missions come with costs that run into hundreds of millions of dollars. Fundamentally, these mission costs arise from the complex technical challenges of achieving high quality, precisely positioned imagery from space. Selected contributing factors include the platform cost, the launch cost (closely related to the satellite mass) and the imager cost. The aperture diameter of an optical payload impacts both the launch cost, where platform volume/mass increases with larger diameters, and the imager cost. It has been demonstrated that the cost of an optical telescope assembly is proportional to the primary mirror diameter, to the power of 1.7 - hence significant mission cost benefits can be realized through reducing aperture size.

However, the clear aperture size imposes a fundamental limitation to the theoretical performance of an optical system, creating a tug-of-war between mission cost and resolution performance. For any given aperture, the aim is to maximize the information content resolved up to this theoretical limit. This can be achieved through minimizing losses caused by aberrations, which may arise from manufacture of optics, imager alignment and thermoelastic effects on-orbit. Additionally, useful information may be lost due to aliasing at higher spatial frequencies; this information can be recovered through processing techniques, enhancing the final product resolution, and providing an opportunity to break the cost vs resolution deadlock.

This paper reports on SSTL work with the European Space Agency and industrial partners under the InCubed programme, in order to develop telescope and sensor technologies that support cost effective VHR imaging on small satellites.