IAF EARTH OBSERVATION SYMPOSIUM (B1)
Virtual Presentations - IAF EARTH OBSERVATION SYMPOSIUM (VP)

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DEVELOPMENT OF SUBMETER CAMERA SYSTEMS IN SMALL FORMFACTOR FOR ASYNCHRONOUS CONSTELLATION OPERATION

Abstract

It is a booming era of satellite constellation: more than 7,000 satellites to be developed by SpaceX, 600 satellites by OneWeb, and hundreds of CANSATs to follow. Projecting the trend in Earth observing industry, there will be secured demands of optical payloads for such constellations, which should have accommodation to available platforms.

In spite of high willingness-to-pay, it may need to be agonized over whether we get off on the right foot to take advantage of the opportunities. Development of the EO payloads has focused so far on taking advantages of physical dimension only and been dependent on a strategy to develop easily or to build in cheaper way. A typical example is a sensor, which is a key element for imaging system but quality degradation of which is allowed to make the systems affordable. This way of developing a payload may be a smart move in a perspective of kicking off business but can be a strategic fatigue that leads to commoditization of EO payloads.

A different strategy is proposed in this article toward developing camera systems for constellation operations: micro in physical dimension but advanced in performance. In designing, it is tried to miniaturize a professional camera system rather than just simplify its configuration. Under the strategy, it has been possible to implement a baseline design of 4-mirror telescope in such a small form factor.

In this context, micro-advanced EO payloads of LIBERO-1 and LIBERO-2 have been designed. Each is designed to have 1-m and 2-m resolution, respectively, in panchromatic spectral channel at an altitude of 500 km. With more than 4000 active pixels in each, they can support up to 6 multispectral channels. The biggest challenge in developing the systems was how to implement a system of complexity, 4-mirror telescope, in such a small form-factor: LIBERO-1 is designed to have its external dimension of 20 cm (W) x 20 cm (H) x 30 cm (L), which is almost half the length of 1-m resolution cameras currently available in market; LIBERO-2 to have a size comparable to regular star sensor's and implemented with an external dimension of 10 cm (W) x 10 cm (H) x 20 cm (L).

The LIBERO systems are advantageous in that they can help formulate gigantic, asynchronous constellation for Earth observation, leveraging satellites already planned for launch, like Starlink by SpaceX, OneWeb, and Kuiper by Amazon so that there is no need of dedicated platform, launcher, and ground station.