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APPLICATION OF COLLABORATIVE AUTONOMOUS CONTROL AND THE OPEN PROTOTYPE FOR EDUCATIONAL NANOSATS FRAMEWORK TO ENABLE ORBITAL CAPABILITIES FOR DEVELOPING NATIONS

Abstract

Prosperous nations, such as those in North America, Europe and elsewhere, enjoy the benefits of numerous orbital remote sensing data products. These data products have applications in map making, urban and rural planning, civil disaster response, agriculture and a plethora of other areas. The spacecraft that provide this imagery are, predominately, large and expensive. They cost tens to hundreds of millions of dollars to make and tens to hundreds of millions of dollars to launch.

Small spacecraft, however, represent a new paradigm for remote sensing applications. They can be used, in conjunction, to capture imagery which can be super-resolved to rival the performance of spacecraft that are larger and significantly more expensive than the whole small spacecraft constellation. Alternately, they can be spaced to provide higher temporal coverage. Various intermediate configurations are also possible, making the collaborative small spacecraft approach extremely versatile.

This paper presents work on three synergistic topics. First, it covers work on orbital super-resolution and mosaicking. This work demonstrates the viability of the on-orbit operations required to combine and/or enhance images for direct user consumption on Earth. Second, it presents work on a set of protocols that can be utilized to share tasks between multiple spacecraft. This includes the imaging tasks required to capture the pictures required for mosaicking and enhancement. It also includes the processing tasks required for performing the mosaicking and enhancement.

Finally, the synergy of these two aforementioned topics is presented: a collaborative mission design to enable a constellation of heterogeneous spacecraft, prospectively with different owners, to collaborate to collect and process data for direct use by users in a developing country. A mission concept is presented and analyzed. The quality and resulting utility of the prospective data is considered. From this, its suitability for various applications is assessed. The paper concludes by discussing the prospective impediments to implementation of this plan. Various approaches to completion are considered.