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Autonomy integration for small satellite payloads: A roadmap

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Abstract: A vast majority of CubeSats in Low-Earth-Orbit (LEO) are limited in their operational capacity due to the inherit constraints of a CubeSat design. However, as the demand to perform complex tasks is ever increasing, there is a growing need for operational autonomy to achieve a higher operational efficiency to fulfill the demanding complexity requirements. A hybrid ground-supported autonomy strategy has been proposed that leverages the distribution of autonomous mission planning between ground systems and the spacecraft creating a robust pipeline, a roadmap, to integrating autonomy on existing platforms. The distributed autonomous mission planning tool has been implemented on Defence Science and Technology Group's (DSTG) Buccaneer Main Mission (BMM) – a 6U CubeSat designed to collect high-frequency (HF) measurements in LEO to better understand radio-frequency (RF) propagation through the ionosphere [1] – under the SCARLET-β: Goal Orientated Autonomy Project Agreement between DSTG, University of Sydney and SmartSat CRC. The spacecraft also houses the Maneuverable Antenna Terrestrial and self-Imaging System (MANTIS) payload designed to capture self- and Earth-observation imagery using a novel deployable optics design [2]. The secondary payload (SPL), MANTIS, of the BMM spacecraft has been the primary focus in validating the autonomous mission planning system's ability to operate the payload under a constrained operational environment. The requirements of integrating autonomy on an existing platform using this approach has been presented as a roadmap, as well as a comprehensive comparison of the operational efficiency using the autonomous approach vs the conventional operating methods. The poster explores the pipeline from initially using simulation to validate the application of autonomy, through to integrating that simulation into a hardware-in-the-loop testbed environment for test and evaluation, seeking to build trust in the autonomous MANTIS tasking system.

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