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EVOLUTION OF ROBOTICS GNC TECHNOLOGY IN AIRBUS FOR PLANETARY EXPLORATION MISSIONS

Abstract

Over the course of the last decade, Airbus has executed a variety of projects oriented towards bringing planetary exploration and GNC technologies to a state of being space qualified. This paper presents an evolution of these GNC advancements. The GNC rover team of Airbus has been involved in planetary exploration programs including ExoMars and Mars Sample Return (MSR). For ExoMars, in the frame of the Rosalind Franklin Mission Rover, the team developed a mobility system that works with different

levels of autonomy: from direct execution of operator defined manoeuvres to fully autonomous long traverses. For MSR, the ExoMars mobility system was adapted to the requirements set for the Sample Fetch Rover (SFR), a rover that was intended for fetching samples on the surface of Mars. The MSR architecture evolved and the SFR was replaced, but promoted the development of novel GNC technologies. For instance, the Integrated BreadBoard (IBB) projects are being executed as a means to motivate evolution and progressively test GNC solutions oriented towards future missions. As a predecessor to hardware benches, Unitary Breadboards were developed to sketch ambition for future activities: including preparing integration with hardware, generalising interfaces, establishing a processor-in-the-loop testing. The first of the hardware breadboards, IBB1 served to set up the breadboard rover platform with the hardware needed for long traverses and to accommodate the ExoMars mobility system. A significant achievement given the many limitations and challenges of working during the COVID-19 pandemic. IBB2 served to significantly improve the autonomous navigation capabilities in many directions. First, to reduce the accumulated localisation error inherent in methods such as visual odometry, a complementary system was integrated and tested named Absolute Global Localisation (AGL). This system matches the maps constructed from the rover's camera images with reference maps. Second, the team successfully demonstrated a rover driving autonomously for 300 metres, visiting a number of waypoints, in one day. Obstacles were positioned along the way, which the rover had to navigate safely through. Thereafter, the mobility and localisation algorithms were validated, in the more controllable Mars Yard environment, on a processor analogous to those space-qualified. IBB3: The third iteration of IBB entailed advances like the design and testing of a novel heading correction method based on sun sensing, validating a proof of concept of the manipulator system to pick up sample tubes and also introducing the operations layer into the integrated breadboard end-to-end system.