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ENHANCING AUTONOMY FOR CLOSE-PROXIMITY OPERATIONS: THE MSCA-FUNDED PROJECT CASTOR

Abstract

A new space era is coming. Numerous miniaturized probes will soon pervade the solar system for commercial and exploration needs.
In the next future, minor bodies will be the final destination of diverse space missions, since they can give answers to the origin of life and provide resources for the sustainable development of the humanity. However, the state-of-the-art is to control space probes from ground. The need for large teams and specific infrastructures yields extremely expensive operations, and poses challenges in terms of cost, scalability, and exploitability for small satellites. Autonomous small probes with guidance and control (G&C) capabilities would simplify operations, reduce costs, and facilitate space exploration. Still, current spacecraft autonomy is limited, and on-board trajectory optimization algorithms face computational constraints.
The CASTOR (Challenging Autonomous Spacecraft through Trajectory Optimization with Robustness) project, funded by the European Commission under the Marie Skłodowska-Curie Actions, aims to develop a framework for robust autonomous G&C for miniaturized spacecraft operating near minor bodies, considering on-board power and computational limitations, with the involvement of two space agencies, NASA and ESA, and Politecnico di Milano. CASTOR implements on spacecraft-compatible hardware an autonomous robust goal-oriented guidance algorithm, specifically designed to cope with scientific and technological constraints about asteroids. Eventually, the hardware-software set will be valited and tested in RAFFAELLO, a laboratory environment at Politecnico di Milano, simulating conditions near a minor body.
The successful implementation of CASTOR will have significant implications for space operations, enabling cost reduction, enhancing scientific exploration, and democratizing space for new operators.