Vision-based Autonomous Navigation using Moon and Earth Images
Doctoral Dissertation Thesis Defense

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Abstract

This research proposes a novel spacecraft autonomous positioning approach based on the optical observation of nearby celestial bodies and describes its development, implementation, and testing. The initial idea was spurred by the need to give the manned Orion vehicle - the next-generation manned spacecraft currently in development at NASA - a backup autonomous positioning system. Orion is designed to transport a crew to and from the Moon and to validate the new technology to bring Astronauts to Mars. The presence of astronauts makes necessary having a backup positioning system. This backup system becomes active if the contact with ground is lost, a critical task during the re-enter into the atmosphere. The solution proposed requires just a visible camera and a high accurate and robust image processing code. The image processing software proposed is able to derive the data needed for trajectory estimation under all kinds of illumination, distance, and partially observed body. The data are the apparent radius and the position center. The trajectory is then estimated with a newly developed algorithm based on Bézier functions. Each of these parts will be discussed in detail.

Francesco de Dilectis is a PHD candidate in the Aerospace Engineering Department working under the supervision of Professor Mortari. His research interests are in the areas of orbit determination and control and attitude estimation. He is seeking employment as a Post Doc or with companies involved with research in orbital mechanics.