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Trajectory and GNC Strategy Design for a Fast Development Mission to Apophis

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ABSTRACT

ESA has recently identified a potential smallsat mission to Apophis as one of its future objectives. In this paper, GMV presents its trajectory and GNC design proposal for such a mission based on its experience with the HERA GNC developments.
The trajectory options and GNC strategies for an Apophis orbiter are addressed with focus on the realistic consideration of constraints that arise for a smallsat platform and a low cost mission, namely: 1) consideration of tight system constraints (thermal, communications, and reduced sensor suite) in the trajectory and GNC strategy designs; 2) Re-use of existing technologies to reduce mission developments costs and to ensure schedule compliance for a mission arrival before Apophis fly-by to Earth on April 2029; 3) minimization of the operational costs by increased AOCS/GNC autonomy.
This paper is divided in five sections:

1. Introduction and overview of a smallsat mission to Apophis;
2. Definition of the mission objectives and constraints (system, operational, cost);
3. Analysis of different trajectory options and selection of the most suitable for a low-cost Apophis mission;
4. Analysis of different GNC strategies and selection of the most suitable for a low-cost Apophis mission;
5. Conclusions and roadmap for the GNC system development of the studied mission.

The consideration of the before-mentioned realistic low-cost missions constraints are critical to ensure a sensible design. One crucial aspect in deriving these was GMV's experience on the design of the proximity operations and GNC sub-systems for small body missions, which allowed for identification of the following constraints:

- Reduced navigation sensor suite;
- Limited actuation accuracy;
- Weak dynamical environment;
- Thermal constraints;
- Constrained communication attitude;
- Reduced propellant budget;
- Reduced ground operational effort.

As the main outcome of this work, GMV's makes the point for a low-cost fast development of a mission to Apophis based on the HERA GNC developments. Furthermore, a first proposal for the mission's proximity operations and GNC strategy definitions is presented along with a discussion on the main challenges and limitations.

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Comments:
For oral presentation.