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KINETIC IMPACTOR FOR A SHORT WARNING ASTEROID DEFLECTION

Abstract

GMV is presenting in this paper its work on the development of a GNC system for a Kinetic Impact mission as a major AOCS/GNC system provider.

Asteroid impacts on Earth are a known source of extinctions and played an important role on life evolution on Earth. This comes as no surprise given the high number of objects orbiting on Earth's vicinity – asteroid impacts become a question of "when" rather than "if".

Under this motivation, thousands of potentially hazardous asteroids (PHAs) are monitored around the globe and naturally the question on the next step rose: What can we do when an incoming asteroid is identified as being in an impact course with Earth? This is the motivation behind the field of Planetary Defence and, most notably, the development of the so-called mitigation strategies.

Several mitigation strategies are being studied but most of these have technology readiness levels still far off from the required. The one that comes closer is the kinetic impactor concept, which is the focus of this work. The concept is simple from a theoretical standpoint – a spacecraft (impactor) is sent into a collision course against the hazard NEO (Near-Earth Object) transferring enough momentum through kinetic energy to slightly change the NEO's trajectory and thus, miss the Earth. The impact physics aspects also come into play, with the scientific community analyzing different techniques and phenomena to optimize the momentum transfer for a successful deflection.

Naturally, this strategy holds intricacies that upon a closer look reveal a rather complex technique. The list of technical challenges to address in order to deflect an incoming asteroid is an extensive one:

- Short platform development time;
- Target's characteristics uncertainty;
- Robustness to successfully hit the target at a high incoming speed close to its centre-of-mass;
- Mission design prepared to deal with targets in a wide range of characteristics;
- Optimization of the linear momentum transfer;
- Confirm the correct deflection.

In order to tackle these challenges, a set of steps are necessary to correctly analyze the feasibility of designing a Kinetic Impactor mission concept whose objective is defined to, within a limited timeframe, adapt an already existing platform to successfully deflect a 50m size incoming asteroid. GMV presents in this paper the different steps that took to study the implementation of a GNC system for such a mission.