

IAF SPACE EXPLORATION SYMPOSIUM (A3)  
Small Bodies Missions and Technologies (Part 1) (4A)

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## KINETIC IMPACTOR FOR SHORT WARNING ASTEROID DEFLECTION

**Abstract**

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”.

In order to prepare, several entities were founded around the globe to monitor objects. Once the targets are monitored and a PHAs (potentially hazardous asteroid) is detected the following question would be inevitable: what can we do when an incoming asteroid is identified as being in an impact course with Earth? This is the motivation between the field of Planetary Defence and, most notably, the development of the so-called mitigation strategies.

Several mitigation strategies are being studied, with different levels of suitability. However, the technology readiness for most of these mitigation strategies is still not in place and a bit far off from being so. 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 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;
- optimization of the linear momentum transfer;
- target's ephemerides uncertainty;
- target's physical 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 large search space (PHAs large orbital range);
- deflect a heavy target with a much smaller spacecraft;
- unknown irregular shape of the body introducing errors on the optical measurements;
- confirm the correct deflection.

In order to tackle these challenges, this study presents a set of steps are necessary to correctly analyze the feasibility of designing Kinetic Impactor mission concept – to successfully, within a limited timeframe, adapt an already existing platform to successfully deflect a 50m size incoming asteroid.