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A FAST RESPONSE NEO IMPACT AND FLYBY MISSION CONCEPT DEMONSTRATOR

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ABSTRACT

A novel mission concept is presented to impact/deflect, flyby, and optionally collect samples from a near Earth object that passes within 5 Lunar Radii of the Earth and does so before 2020. In general, we address the concept of intercepting all future NEO's that meet certain close approach criteria and that can be accessed by operational, commercial flight systems. Two distinct flight regimes are considered: 1) NEO interception for objects that can be accessed inside the Moon's orbit using highly elliptical orbits, and 2) Interception of objects outside the Moon's orbit using lunar gravity assist due to performance limitations of the flight systems. We consider options that include a single impact vehicle (impact/deflect only mission), an impact and flyby using two vehicles, where the flyby vehicle observes the impact, and an extended option that has the flyby vehicle return to the Earth after flying through the debris field generated by the impact, collecting particle samples, and returning them with an atmospheric reentry spacecraft.

In the first example mission, we discuss the details and feasibility of a mission to the near Earth asteroid 2012 TC4, a 15m to 30m diameter object and one of the few indentified asteroids that will pass within half the moon’s distance before Apophis in 2029. 2012 TC4 will have a flyby of Earth at a close approach distance of about 130,000 km on October 12, 2017. This mission concept uses a single commercial launch vehicle to inject two spacecraft into a highly elliptical orbit with an apogee at the asteroid’s closest approach point and time. The first spacecraft is an impactor that will collide with the asteroid at hypervelocity (>7.5 km/s). The second spacecraft flies by the debris plume field created by the impact a short time later to observe the impact and possibly collect particles for a near-free return to Earth.

In the second example, we consider an impact only mission to an object whose closest approach distance is beyond the Moon's radius, but within 5 lunar radii. Here we use a single lunar flyby to precisely target the NEO at its closest approach to the Earth. The details of this specific mission profile are still being generated as of the writing of this abstract.

A general mission architecture will be outlined, and trajectory design and performance details will be presented for selected mission opportunities. A top level cost assessment will be made for missions that can be performed with existing commercial flight system assets and impactors.