PDC2023
Vienna, Austria

(please select the topic that best fits your abstract from the list below)
(you may also add a general comment - see end of this document)

<u>NEO Characterization</u>

ASSESSING THE CAPABILITIES AND LIMITATIONS OF FLYBY MISSIONS FOR PLANETARY DEFENSE CHARACTERIZATION

Jodi Berdis[1], Hari Nair[1], Anna Martin[1], Terik Daly[1], Carolyn Ernst[1], Olivier Barnouin[1], Justin Atchison[1], Ry Bull[1]
[1]*Johns Hopkins University Applied Physics Laboratory, Laurel, MD*
Presenting Author: Jodi.Berdis@jhuapl.edu

Keywords: *NEO Characterization, Flyby Missions, Planetary Defense Properties*

ABSTRACT

A near-Earth object (NEO) that poses a threat to Earth must be characterized in order to understand the severity and consequences of the threat and to determine a course of action. Constraining asteroid properties such as orbit, mass, presence of binary objects, shape, rotational state, composition, internal structure, material properties, surface topology, and presence of dust/coma can help inform mitigation strategies. Flyby characterizations have several schedule and operational benefits for planetary defense, e.g., flexible launch windows, reduced propellant, and less complexity. But questions remain about how well a flyby can measure planetary-defense-related quantities versus a rendezvous. This knowledge gap must be filled in order to mount the best response in the case of a real threat to Earth.

Our study objectives include:

1. Generate real and simulated imaging datasets that are representative of what an asteroid flyby mission would return under various encounter conditions.
2. Analyze the datasets using the tools and methods that would be used in a real-life situation.
3. Assess how well the analyses constrain asteroid properties relevant to planetary defense, and whether they are sufficient to inform mitigation strategies.

We created simulated spacecraft images using a half-size Bennu shape model as the target asteroid; additional asteroid shape models will be used in future assessments. Images were simulated for spacecraft encounters that sampled a range of phase angles, closest approach distances, flyby speeds, and camera capabilities. With these synthetic image sets, we built shape models using stereophotoclinometry (SPC) to calculate the asteroid's size/volume, and identified volume improvements of the reconstructed shape model compared to the truth shape model. We also assessed

how well we could constrain the asteroid's mass using flown and in-development gravity science methods, and we conducted image analyses in the Small Body Mapping Tool (SBMT) to characterize surface properties of the synthetic NEO, including boulder distribution.

We will present our findings from this study, which included specific flyby characteristics that can minimize the volume error and ensure maximum return of key planetary-defense-related properties. These results elucidate whether the information gathered from flybys are sufficient to characterize an NEO threat for the purpose of exploring future mitigation techniques.

****

Comments:

Oral presentation preferred.