PDC2021
Vienna, Austria

☐ **Key International and Political Developments**
☐ **Advancements and Progress in NEO Discovery**
☒ **NEO Characterization Results**
☐ **Deflection and Disruption Models & Testing**
☐ **Mission & Campaign Designs**
☐ **Impact Consequences**
☐ **Disaster Response**
☐ **Decision to Act**
☐ **Public Education & Communication**

A NEW METHOD FOR ASTEROID IMPACT MONITORING AND HAZARD ASSESSMENT

Javier Roa[1], **Davide Farnocchia**[2], **and Steven R. Chesley**[3]
[1] *Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr, Pasadena, CA 91109. Javier.roa@jpl.nasa.gov*
[2] *Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr, Pasadena, CA 91109. Davide.farnocchia@jpl.nasa.gov*
[3] *Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr, Pasadena, CA 91109. Steve.Chesley@jpl.nasa.gov*

Keywords: *asteroid impact monitoring, probability estimation, hazard assessment, near-Earth asteroid*

ABSTRACT

Determining the orbit of an asteroid consists in finding the orbit that best fits a set of available observations. The uncertainty associated with the orbit fit may be compatible with orbit solutions that impact Earth. We present a new method for detecting and characterizing such impacting solutions by incorporating the impact condition as an additional observation into the orbit-determination process. The residuals of the impact observation are the B-plane coordinates at the time of close-approach, and the uncertainty is set to a fraction of Earth's radius. The estimation process converges naturally to the impacting solution as long as it is compatible with the available data. The uncertainty of the impacting solution scales with the uncertainty of the impact observation and models the region in parameter space leading to impacts along that particular dynamical path. Having delimited the set of initial conditions and parameters leading to an impact, we estimate the impact probability using importance sampling. The proposed algorithm can robustly handle various configurations for the estimated parameters, and it makes no particular assumptions about the initial orbit uncertainty distribution beyond it being Gaussian. This feature makes the algorithm particularly useful for processing asteroids whose orbits are affected by nongravitational forces in a statistically significant way. The

algorithm has been implemented into a new impact monitoring system at JPL, called Sentinel. The system is in the final stages of development and testing before becoming fully operational. We present extensive results to assess Sentinel's performance compared to existing impact monitoring systems based on the line of variations and discuss selected cases in detail.

****

Comments:

Oral presentation preferred.