PDC2021
Vienna, Austria

Please submit your abstract at https://atpi.eventsair.com/7th-iaa-planetary-defense-conference-2021/abstractsubmission

You may visit https://iaaspace.org/pdc

(please choose one box to be checked)
(you may also add a general comment - see end of the page)

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

SIMULATING PLANNED LICIACUBE IMAGERY OF DART IMPACT EJECTA BASED ON EJECTA DYNAMICS SIMULATION OUTPUT

Eugene G. Fahnestock[1]**, Emily Kramer**[1]**, and Steve Chesley**[1]
[1]*Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA, 91109, USA, +1-818-486-1335, eugene.g.fahnestock@jpl.nasa.gov*

Keywords: *DART, LICIACube, kinetic impact, ejecta, image simulation*

ABSTRACT

The planned impact of the ~600 kg Double Asteroid Redirection Test (DART) spacecraft with the surface of Dimorphos, the secondary member of the 65803 Didymos binary near-Earth asteroid system, at between 6.12 and 7.25 km/s in late September to early October 2022 is expected to generate a large quantity of ejecta. The Light Italian CubeSat for Imaging of Asteroid (LICIACube), a 6U CubeSat element contributed by the Italian Space Agency (ASI), is nominally planned to be released from DART 10 days prior to encounter and make a flyby of the target at essentially the same velocity with which DART impacts the target. LICIACube will pass through a closest approach distance to Dimorphos of about 55 km about 165 seconds after the impact, taking images of the event with its two cameras to reveal the structure and short-timescale evolution of the DART impact ejecta plume, among other things.

In this contribution we detail recent work at JPL to simulate how the ejecta presents within these planned images. For this we combine a previously developed and

mature methodology for dynamic simulation of ejecta with software previously developed for simulating the appearance of dust from comets or so-called “active asteroids” in the field of view of space-based telescopes (e.g., NEOWISE).

Ejecta tracer particles are randomly initialized in a local frame at the impact location according to crater scaling equations, with an assumed size-frequency distribution. Their initial states are translated to and then propagated within a Didymos barycentric inertial frame, for up to 90 days duration or until reaching the possible fates of re-impact with Dimorphos, transfer-impact to Didymos, or escape from the system far anti-sunward. This dynamic simulation of ejecta occurs under the influence of both binary component’s gravity and all other relevant forces (SRP, including shadowing, and differential solar gravity, or “solar tides”). The underlying binary components’ motion is in turn output from post-impact simulation of the full two body problem assuming impulsive state modification at time of impact consistent with an assumed value of the momentum multiplier, Beta, and the DART impact geometry.

At each desired instant of image acquisition according to current LICIACube observations planning, we capture the 3D spatial number density of the full ejecta population in each particle size bin, scaled from the population of simulated ejecta particles in that size bin, within a spatially gridded interface file. This is read by the image simulation software which maps brightness, according to a proper photometric light scattering model, of the ejecta within non-empty cubes and sub-cubes of the spatial grid onto the pixels of the camera field of view. LICIACube’s Didymos-relative trajectory and assumed nominal pointing control are used to position and orient the cameras.

****

Comments:

Submission for poster presentation

While the session or track selected above is “Deflection and Disruption Models & Testing” because this work deals with the effects of proposed NEO deflection in terms of ejecta, it also obviously fits under the highlight/spotlight topic area of activities related to the two planetary defense missions in development: DART (NASA) and Hera (ESA). Since this work is also on a planned flight mission to NEOs, it could also perhaps fit under the “NEO Characterization” session or track, but it concerns simulations, not observed results.