A dedicated simulation chain for Hypervelocity Impacts effects on DISC sensor

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Comet Interceptor is an ESA Fast-class space mission, which will be launched in 2029 towards an as-yet undiscovered Dynamically New Comet, i.e. never having approached the Sun before, or even an interstellar body. Comet Interceptor consists of three spacecrafts that will flyby the selected DNC. DISC sensors (part of Dust Field and Plasma suite) will be mounted on board two of the three foreseen S/C, aiming to determine cometary dust dynamical properties retrieving information from the particles impinging its sensitive surface. The DISC sensing plate will be exposed to the cometary dust environment thus subjected to Hypervelocity Impacts (HVI), due to the high speed of the flyby (10 - 70 km/s). Nowadays facilities don't let to test all the possible impact cases DISC will be subjected into the cometary environment (very high relative speed during flyby). To overcome this limitation, we set up a simulations system for the sensor with ANSYS ™ software and AUTODYN ™ hydrocode, capable of simulating a wide range of impacts characteristics (e.g. speeds, particles sizes) DISC will face during the operative phase. The simulation system involves a hybrid model discretized with both Smooth Particles Hydrodynamic (SPH) and Finite Element methods, and it is organized in two main steps: 1. The first step includes the region very close to the impact point, discretized with SPH. Here is reproduced the impact and the impacted surface evolvement from the generated shockwave, large material deformation and compression, till the formation of Lamb waves and the start of the elastic regime. 2. The second step is a transient structural analysis involving Finite Element discretization. The output of the previous step is used as input for this second one, which is applied to the entire DISC sensing plate to obtain the HVI effects till the plate edges, where PZT sensors are placed. This simulation considers the PZTs characteristics to get as output of the simulation the PZT signals. Impacts by different particles diameters and velocities have been simulated. Here we report the simulations system and some of the most relevant final outputs.

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