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SINPLEX: A SMALL INTEGRATED NAVIGATION SYSTEM FOR PLANETARY EXPLORATION

Abstract

Navigating spacecraft through the solar system is one of the most technically demanding challenges imaginable. The FP7 SINPLEX project aims to bring together key sensor functionalities used in solar system navigation and to further improve the off-the-shelf capabilities. This is enabled through miniaturization of sensor hardware, data fusion from different sensors and hardware integration of sensors. The flight design of the SINPLEX instrument has a mass of 4.8 kg and is packed with redundant sets of star trackers, navigation cameras, Inertial Measurement Units (IMU) and laser altimeters. The two navigation cameras have a partly overlapping field of view to enable stereoscopic observations. The combination of these sensors should provide reliable, robust and high frequency information on the (relative) position and attitude such to enable the host spacecraft to perform timely and well-informed attitude and orbit actuation. The specification of the SINPLEX instrument was established taking into account four different mission scenarios: 1) Lunar descent and landing 2) Asteroid descent and landing 3) Container rendezvous and capture 4) Mars entry, descent and landing These four mission scenarios each pose different challenges with respect to required functionality but we were able to create an instrument architecture (in combination with an assumptive spacecraft geometry) capable of sustaining all four scenarios. A hardware breadboard of the SINPLEX instrument is currently under construction with which we aim to reach Technology Readiness Level (TRL) 4, i.e. a component and/or breadboard validation in laboratory

environment. This 3.4 kg instrument represents a non-redundant version of the flight model design. The redundancy is not necessary for the validation of the TRL-4 level and also minimizes project cost. The instrument housing is produced with the investment casting technology that enables integration of functionalities to the maximum extent. This technology is not yet space qualified but offers a great number of advantages. One of them is that the mechanical designer has full freedom to create structures that are otherwise not possible, i.e. with conventional production technologies such as diamond turning. This paper will address a description of the design as based on the mission requirements, the progress of the breadboard and the advanced testing planned in two DLR facilities namely TENSOR (Test Environment for optical Navigation Systems On airfield Runway) and TRON (Testbed for Robotic Optical Navigation).