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SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations (IP)

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CHARACTERIZATION, OBSERVATION, MAPPING, AND PROXIMITY APPROACH SENSOR SYSTEM (COMPASS)

Abstract

The Asteroid Redirect Mission (ARM), planned by NASA for the 2020s, will execute spacecraft navigation to a small carbonaceous near-Earth asteroid, characterize the asteroid, approach and capture the asteroid. The asteroid will then be transferred to a Moon-Earth system for further exploration by astronauts. An alternate mission is to retrieve a boulder from the surface of an asteroid and transfer it to a near-earth location for further exploration. The COMPASS sensor suite will support either scenario by providing mission critical sensor data required for asteroid detection, tracking, mapping, close proximity and capture operations. The ARM mission main challenge is its target asteroid which is smaller, has lower albedo and rotates faster compared to other asteroid missions (NEAR, Hayabusa, and OSIRIS-Rex). The COMPASS modular sensor suite, made up of space proven high performance components, provides a task-tailored solution to meet the tasks associated with the ARM mission. ARM mission tasks include: Asteroid rendezvous: Long range detection and tracking of a small low albedo, fast spinning asteroid under variable light conditions Asteroid Characterization: Determination of asteroid size, shape, spin state, mass and inertia properties while providing scientific data and surface properties Proximity operations, and capture: Generation of accurate sensor data, required for fast rate real-time relative pose estimation, in support of approach and capture COMPASS comprises reliable, high space heritage high performance modules including: Lidar, IR Camera, Wide Angle and Narrow Angle FOV Cameras, Lights and Electronics. ARM mission requirements are met by use of multiple sensors for each of the following tasks: Rendezvous to asteroid: In the far-field, the high resolution cameras provide bearing, and in the mid-field the combination of cameras and high speed lidar provide range and bearing. Mapping and characterization: Accurate surface 3D mapping data is gathered by the scanning lidar. Appearance features provided by the cameras, augmented by IR camera and lidar intensity data, help determine the asteroid's surface composition. Proximity and capture operations: High rate, pose estimation is provided by the lidar for closed-loop control. The Wide FOV camera with light provide a robust consistency check. The modular COMPASS sensor suite may be tailored to meet the requirements of future rendezvous and landing missions supporting both science and operational tasks. The COMPASS sensor suite solution maximizes use of Canadian Technologies and meets all ARM rendezvous sensor requirements while maintaining affordability.