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MICROGRAVITY SCIENCES AND PROCESSES (A2)
Microgravity Experiments from Sub-orbital to Orbital Platforms (3)

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INVESTIGATION TO DETERMINE ROTATIONAL STABILITY OF ON-ORBIT PROPELLANT STORAGE AND TRANSFER SYSTEMS UNDERGOING OPERATIONAL FUEL TRANSFER SCENARIOS

Abstract

The need and demand for long term space missions, such as missions to Near Earth Object's (NEO's) and interplanetary missions, is growing rapidly. To satisfy this demand, on-orbit propellant storage and transfer technologies are being developed. The ability to re-fuel a space system, once on-orbit, will provide a means of success for these types of space missions without the need for continual development and advancement of heavy lift vehicles. Additionally, the adaptation of existing technology will allow on-orbit refueling of spacecraft to become a near term reality, cutting the need for advanced heavy launch vehicle development as well as the corresponding cost, time, and manpower. Currently, the United Launch Alliance (ULA) is developing on-orbit propellant storage and transfer systems that are derived from the Centaur upper stage of the Atlas launch vehicle. Once on-orbit, these systems will be spun stabilized about their major axis while several propellant transfers take place. During these propellant transfers flowing liquid propellant, pressure gradients, and liquid slosh caused by the oscillatory motion of the space system are anticipated to pose a drastic change on the system's rotational dynamics. To further advance propellant storage and transfer technologies, the dynamics of on-orbit propellant transfers need to be understood. By successfully simulating on-orbit propellant transfer scenarios of ULA's Centaur derived on-orbit propellant storage and transfer system in a microgravity environment, the rotational dynamics of the system, whilst undergoing these transfers, can be physically measured. The data gathered during the experiment will be used to determine the rotational stability of the space system during on-orbit operations thus increasing the Technology Readiness Level (TRL) of cryogenic propellant transfer systems.