Paper ID: 26615
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MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Sciences Onboard the International Space Station and Beyond - Part 1 (6)

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DESIGNING A MICROGRAVITY FLUIDICS EXPERIMENT FOR USE ON-BOARD THE INTERNATIONAL SPACE STATION

Abstract

This paper details the design of a microgravity fluidics experiment for use on-board the International Space Station. The purpose of the experiment is to investigate the development of droplets produced when a liquid issues from a circular nozzle at a constant flow rate in a micro-gravity environment. A compact experiment has been designed that consists of a liquid injection assembly and a viewing chamber assembly which includes image recording capability. The experiment provides precise control of the flow velocity (Reynolds and Weber number) via a syringe pump driven by a stepper motor and records the surface profiles of the produced drops via a high resolution stereoscopic camera. Fluid properties (pressure and temperature) and system state properties are monitored and logged. To fulfill to the scientific requirements of the investigation a large number of experiments (>1,000) are required to be performed to provide statistically relevant results on the drop formation dynamics. To avoid the requirement for a large fluid and waste reservoir, this experiment incorporates a novel centrifugal separation and recovery system to recirculate and reuse the waste fluid. The whole experiment has been designed to conform to a standard 1U payload slot (110x100x100mm), weigh less than 1kg and consume less than a 2W peak supplied power. The experiment contains only a 16.4mL reservoir of water, and will be capable of creating flows with Reynolds numbers ranging from 1 to 620. The entire system is powered through a setup of eight super-capacitors which recharge via a 2W power supply, and is controlled by a compact microcontroller. With an estimated operational cycle length of 360 seconds, the experiment works through three main operational modes – injection and visual recording, centrifugal spin and liquid gathering, and liquid return. Captured surface profiles are processed on-board to provide drop diameter and time of formation as well as a transient record of position. This paper describes the configuration, operation and capabilities of this experiment. Additionally the process of designing small complex experiments for the ISS, and the challenges that this present, are discussed.