NASA STTR 2017 Phase I Solicitation

T6.02 Liquid Quantity Sensing Capability

Lead Center: JSC

Technology Area: TA6 Human Health, Life Support and Habitation Systems

In the current design of the Advanced Space Suit, the water necessary to provide cooling to the human and avionics is stored in the Feedwater Supply Assembly (FSA) which resides inside the habitable volume of the Space Suit. The FSA is a flexible reservoir which takes advantage of the suit pressure as the means of maintaining water loop pressure at operation conditions. During the EVA timeline, it is paramount that crew member cooling is uninterrupted. An interruption could cause overheating of the crew member. Therefore, insight in to the quantity of water remaining is important.

The ability to determine the quantity of a consumable liquid (e.g., water for cooling) remaining in a soft-walled, flexible reservoir via the use of one (ideally) or more sensors presents a difficult challenge for spaceflight applications. It presents a problem because the reservoir is flexible and it will be in micro-gravity during operation.

Typically, flexible reservoirs in micro-gravity are maintained at a relatively constant external pressure. Therefore, they will collapse as the liquid is consumed from the reservoir. This occurs as such a low rate, it has presented a challenge for traditional flow rate sensors. Also, numerous conditions contribute to the challenge. These challenges include the potential for gas(s) to be entrained in the liquid, the presence or lack of a gravity gradient, and motion of the liquid within the reservoir. Additionally, the constraints of spaceflight cause even more challenges such as:

- Sensor systems must be optimized for minimal mass, volume, and power consumption.
- They must be highly reliable and require minimal maintenance.
- Must cause minimal hazards to the vehicle, crew, and mission.