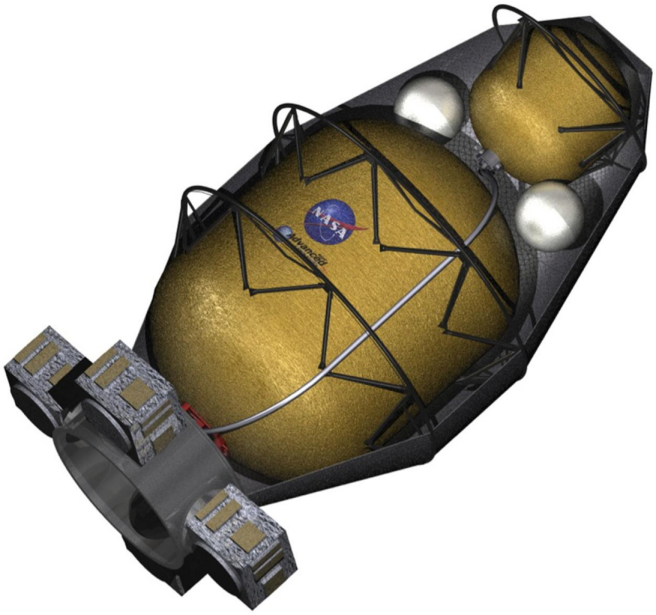

National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Instrumentation

Capacitive Micro-Gravity Fluid Mass Gauge

An Accurate Method of Measuring Fluid or Gas Inside a Vessel

Measuring fluid mass in micro gravity, where fluid behavior is dominated by fluid properties, is a challenging problem. To address this problem engineers at NASA are developing a capacitance-based, mass-fraction gauge for vessels containing two-phase fluids. The vessel volume is enclosed with an array of electrodes, and a unique set of capacitance measurements of the enclosed volume are made between the electrodes. The capacitance measurements are scaled with appropriate weighting factors derived from Laplace's Equation to compensate for the highly non-uniform electric fields inside the measurement volume and achieve a greater level of mass fraction accuracy.

BENEFITS

- Accurately Measures Fluid Mass
- Senses Entire Tank Volume
- Scalable to Different Sized Tanks

THE TECHNOLOGY

The capacitive micro-gravity fluid mass gauge with spatial regularization is a sensor that can be outfitted to propellant vessels and can provide a determination of the mass of liquid and gas inside the vessel volume with a determinable level of accuracy. The sensor consists of 1) a number of discrete electrodes that are installed to the inner surface of the vessel wall, 2) signal generating, digitizing, signal conditioning, and general support (e.g., power supply) electronics, 3) electrical connections between the electrodes and the electronics, and 4) the algorithm used to turn the set of capacitance measurements (i.e., the capacitance matrix) into a volume fraction. The electronics generate and apply a sinusoid to a single electrode, and then the electronics measure the charge on all other electrodes. Capacitance is simply the charge divided by the voltage. This is repeated for all electrodes, without repeating duplicates. For a vessel with a fixed volume, the volume fraction can be converted to the mass fraction using the Ideal Gas Law so long as the fluid constituents, temperature, and pressure are known.

APPLICATIONS

The technology has several potential applications:

- Tank and Vessel Transport
- Gas and Liquid Systems
- LNG Storage
- Hydrogen Storage
- Cryogenic Liquids Storage

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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