MAGNETIC SENSING TO DETERMINE MATERIAL FLOWS AND ELECTRICAL SHORTS

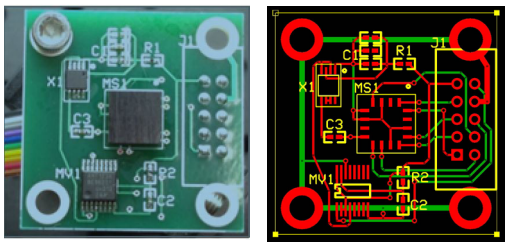
US Patent Application No. 16/124,046
SD 13162
Technology Readiness Level: 3
Analytical and experimental critical function and/or characteristic proof of concept

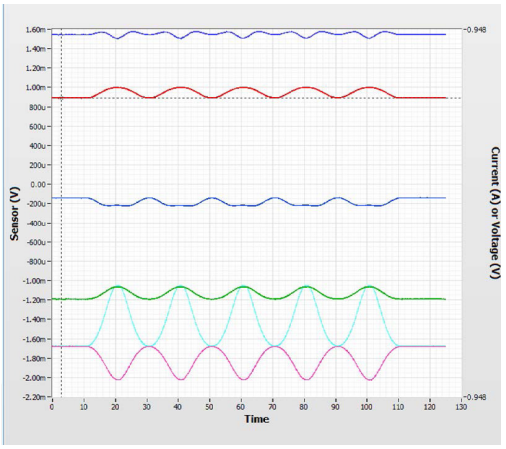
A NON-DESTRUCTIVE FLUID VISUALIZATION TECHNIQUE

Many research applications have a critical need for flow and electrical-current diagnostics within fluids; however, current flow visualization techniques require optical access which is often infeasible in high-temperature high-pressure (HTHP) opaque vessels. Researchers at Sandia National Laboratories developed a non-destructive visualization technique to create a three-dimensional (3D) real-time image of fluid motions and electrical current pathways within sealed vessels under HTHP conditions.

GAIN INSIGHTS WITH MAGNETIC FIELD DIAGNOSTICS

In this technique, the fluid is seeded with magnetic dipole particles and a time-varying magnetic field is applied to produce a known initial condition for the rotation of the particles. The resulting 3D time-varying map of particle paths is observed external to the vessel using commercially-available magnetometers. Optimization algorithms are then used to calculate the particle migration and velocity in time. This technique can be adapted for the observation of stress or temperature changes within fluid flows, and may have applications within hybrid X-ray/magnetic techniques.





Photograph and diagram of magnetometer circuit board (top left and right). A two sensor data recording of the translation of a 1/8" diameter NdFeB magnetic sphere undergoing 10 mm sinusoidal translation at 0.05 Hz (bottom).

TECHNICAL BENEFITS

- Non-destructive visualization of fluid motions, electrical current pathways, and stress / temperature changes within sealed vessels under HTHP conditions
- Less expensive than competing X-ray based techniques currently in development
- Improved safety and effectiveness

INDUSTRIES & APPLICATIONS

- Oil & gas
- Chemical manufacturing
- Occupational safety / monitoring
- Industries developing new rheological techniques
- Thermal decomposition of explosives
- Heat-exchanger optimization
- Liquefaction of organic materials
- Porous media flows

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