High Accuracy Vector Helium Magnetometer (HAVHM)

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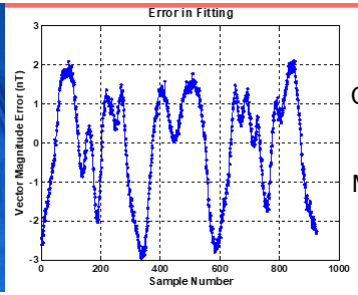
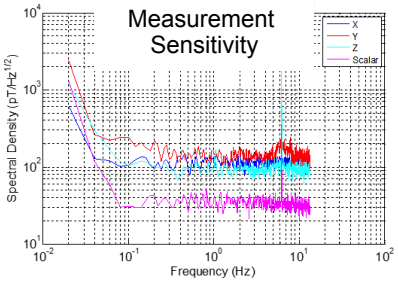
Objective

- Design, fabricate, and calibrate a compact High Accuracy Vector Helium Magnetometer (HAVHM) for Earth Science applications.
- Reduce size, mass, and power by using CubeSat dimensions as a design goal.
- Provide vector and scalar measurements from a single instrument.
- Utilize scalar measurements to self-calibrate the vector component measurements.
- Achieve superior calibrated vector accuracy (±1 nT per axis) not possible with fluxgate magnetometers.



Self-Calibration Residual Vector Magnitude Error



Accomplishments

- Replaced two separate instruments with one instrument, sized so that the electronics and sensor units each fit within the 1U CubeSat size and mass limits, which makes the HAVHM feasible for small satellite platforms.
- Characterized and optimized performance using triaxial magnetic coil facilities at Polatomic and GSFC.
- Performed environmental testing for temperature and vibration for typical LEO conditions.
- Demonstrated noise floor (sensitivity) values of 36 pT/√Hz for the scalar measurements and <138 pT/√Hz for the vector measurements in the scalar/vector mode-multiplexing configuration.
- Achieved a calibrated vector magnitude accuracy of 1.35 nT_{rms} ('thin-shell' calibration @ 46,000 nT).
- Conducted a flight test of the HAVHM towed by a DC-3 aircraft, recording data in Scalar, Vector and Mux modes. Both clockwise and counter-clockwise flight box paths were flown during 5.5 hours of flight time. Scalar and vector modes performed as expected.

Co-Is/Partners: Robert E. Slocum, Polatomic, Inc.

TRL_{in} = 4 TRL_{out} = 6