An Intelligent Digital Fluxgate Magnetometer Payload

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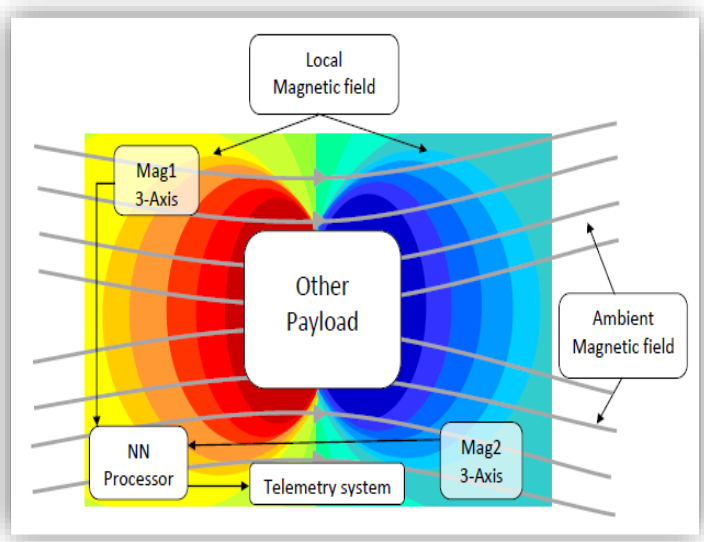
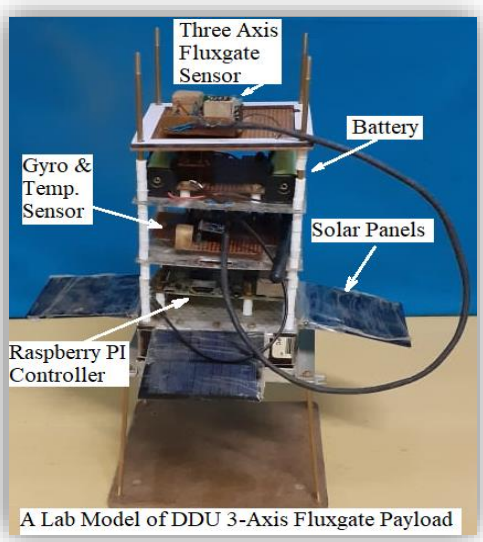
Vector magnetic field measurement in space in the range of ±512nT with resolution of 100 pT is strongly desirable and challenging task. Magnetometer payloads always face challenge of field contamination due to residual dynamic magnetic fields of spacecraft. Long boom deployment of magnetic sensors to overcome residual magnetic fields imposes further structural challenges and discourages such experimenters in complex planetary missions. It is propose to develop proto type of Fluxgate magnetometer payload system with enhanced performance and reliability using digitally improved signal to noise ratio. It is also propose to use multiple such sensors to map both residual magnetic fields of spacecraft and desired vector magnetic field to be measured using machine learning algorithms. Experimenters of Dellingr project of NASA space missions are proposing similar concept [1].Different combinations of vector magnetic field measurements inside the spacecraft and in near vicinity using short boom will be explored to predict desired field values in presence of unwanted space craft residual magnetic field. This will need necessary minimal infrastructure to train, test and calibrate the performance of the system in ground. This calibration system will be designed as part of the smart payload system.

The key concept of such development is to use multiple sensors to measure combined fields and isolate each other using machine learning algorithm like feed forward type neural network. Initially two fluxgate sensors will be used to conduct training experiments in





A Lab Model of DDU 3-Axis Fluxgate Payload

ground, one inside the grounded space craft and other outside the space craft with a short boom of few feet. A helmholtz coil outside will be used to generate test vectors for training. Once trained, the neural net will be used as predictor for desired field value in space.

The above figure shows Block Diagram of Short Boom Magnetometer payload using Satellite Magnetic Field Compensation approach. Each magnetometer reads the ambient magnetic field along with a portion of payload generated time varying magnetic field. An on-board Neural Net based predictor reads both magnetometers and extracts ambient vector field.

References: [1] https://www.nasa.gov/feature/goddard/2017/nasa-technologist-develops-self-alibrating-hybrid-space-magnetometer.