Development of a Uas-Based Electromagnetic Induction Sensor for Subsurface Conductivity Mapping

Andrew Wilson *, Geophysical Engineering, Montana Technological University, Butte
Xiaobing Zhou, Geophysical Engineering, Montana Technological University, Butte

*Indicates Presenter

The Electromagnetic Induction (EMI) method is a popular and favorable geophysical technique for shallow subsurface exploration because of its high-quality, rapid data acquisition of subsurface conductivity or resistivity. However, EMI based instruments are generally ground-based. Our research aimed to investigate the practical application of an airborne EMI sensor that does not require direct contact with the ground. The objective for our project was to measure the inductive response of a conductive subsurface, and locate anomalously high subsurface zone in conductivity. To address our objective, we designed and constructed a lightweight EMI sensor for an unmanned aircraft system (UAS) based on the principles of EM induction and EM sounding. We successfully tested the instrument by measuring the secondary field response from a metal-cased Unexploded Ordinances (UXO) during its high conductivity. The innovative design and construction of our EMI sensor is original and has shown to be a practical approach for use with an UAS. The EMI sensor consists of a signal wave generator, a power amplifier, concentric transmitter and a receiver coils, and a microcontroller-based data collection and storage system. The micro-controller code for the data collection and storage system was developed in the open-source Arduino Software, Integrated Development Environment (IDE). EMI sensors operate using a transmitter coil to generate a primary magnetic field that penetrates into the subsurface and induces eddy currents in conductive subsurface Earth materials. A secondary magnetic field generated by the eddy current induced in the conductive Earth material will pass through the receiver coil, and generating an electromotive force (emf). By measuring the emf induced in the receiver, we can approximate the conductivity of Earth material.