Measuring the Magnetic Signature of a Small Electrically-powered Fixed-wing Unmanned Aircraft System for Mineral Exploration

L Tuck[1], C Samson[1], J Laliberté[2], MWells[3], F Bélanger[3], L Sander[3]

[1]Department of Earth Sciences, Carleton University, Ottawa, Ontario; [2]Department of Mechanical and Aerospace Engineering, Carleton University, Ottawa, Ontario; [3]Sander Geophysics Ltd, Ottawa, Ontario

For over 70 years, exploration companies have been performing airborne geomagnetic surveys from manned aircraft. Through these recordings of the earth's magnetic field, rocks can be differentiated based on their physical properties and can be used to identify structures in the subsurface that can vector towards ore deposits. Regional scale, lower-resolution surveys have been performed over much of Canada, yet higher-resolution surveys needed to map these mineral structures are still needed. In more recent years, unmanned aerial vehicles (UAVs) have drawn considerable attention as platforms for autonomous multi-sensor operations that may be effective for this type of survey as compared to traditional manned aircraft and ground-based platforms. Canada has taken a leading role in the UAV industry with one of the most permissive regulatory environments for small UAV operations. The usage of UAVs for magnetic surveying has been attempted by a few avant-garde industry leaders and research groups. However, issues arise from employing methods that do not transfer from manned platforms, and interference sources from the UAV platforms are often cited as the primary barriers to more widespread use. Corvus is a small (21kg, 3m wingspan) electrically-powered fixed-wing UAV built with carbon fibre and fibreglass at Carleton University and is designed specifically for magnetic surveys. As with all aircrafts, the highly conductive and magnetically susceptible components of the platform will interfere with the magnetic signal recorded. Therefore, magnetic characterization of the aircraft is needed to identify regions of low magnetic interference in order to suggest optimal locations for mounting magnetometer instruments. Characterization studies of the Corvus UAV involved 3 experimental investigations performed at the Ottawa Geomagnetic Observatory using a GEM Systems GSMP35-UAV total-field magnetometer. First, a spatial map of the aircraft was made identifying the location of the main sources of magnetic interference. Second, the interferences from the actuation of each flight surface of the aircraft at 11 different mounting points were measured. Lastly, a spatial characterization of the 6kV electric motor used for propulsion was evaluated using total-field and the 4th difference noise metrics. A weighted index overlay analysis was used to evaluate the total-field and gradient character of the aircraft and to choose the best location(s) for the magnetometer(s).