Synergy between terrestrial and space technologies: auto-synchronized 3D-laser imaging and electromagnetic induction sounding

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Technological development for terrestrial and space applications is often closely interrelated. In one scenario, a proven terrestrial technology or scientific instrument is ported to space. Inversely, technologies developed for the rigors of space can find new uses in challenging terrestrial environments. This presentation will focus on two versatile Canadian technologies adapted to both terrestrial and space applications: auto-synchronized 3D-laser imaging and electromagnetic induction sounding.

The principle of auto-synchronized 3D-laser imaging originated at the National Research Council in Ottawa and was later adapted for space by Neptec Design Group of Kanata, Ontario. Neptec's Laser Camera System (LCS) projects an infrared laser beam on a target with rotating mirrors, and focuses the reflected light onto a linear detector array to obtain 3 spatial coordinates and intensity (X, Y, Z, I). The system is currently used during shuttle missions on low-earth orbit to inspect the orbiter's tiles for potential damage following liftoff. In an interesting twist, the system has recently found new terrestrial applications: non-intrusive measurement of the volume of rare and fragile meteorites, and fracture mapping in an underground mining environment.

Canada is a world leader in electromagnetic geophysical techniques, which have been credited with numerous mineral deposit discoveries since World War II. In electromagnetic induction, a transmitter outputs a time-variant, primary magnetic field which generates electrical currents in the subsurface. These currents, in turn, induce a secondary magnetic field which is recorded at the receiver. The Electromagnetic Induction Sounder (EMIS) is a compact instrument based on this principle. Hosted in a one-metre long tube, the instrument measures the electrical conductivity and magnetic susceptibility in the few first metres of the subsurface, e.g. for the characterization of agricultural soils and ice wedges in arctic polygons. The EMIS is of interest to the space community because of potential use to detect brine pockets in the near-subsurface of Mars.

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