Mineral Exploration Mapping Tools Using Machine Learning and Drone Geophysics

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Remote sensing methods and applied geophysics techniques gather information about subsurface structures without disturbance. Airborne surveys are preferred due to their speed, safety, and cost-effectiveness. Drone-based geophysical surveys are versatile, fast, economical, and ecologically friendly. However, drone payloads have limitations. Some geophysical methods are unsuitable for drones, and some may be prohibited by law. Drones have new opportunities in mining operations, especially for local scale support for ore and top cover volume estimations by repeated photogrammetry and LIDAR, constructions, and a general understanding of geological bodies in large-scale pit mining. Magnetic measurements are the most mature technology, while electromagnetic sounding and gravimetry are still developing.

In DroneSOM, Radai is developing a drone-based geophysical electromagnetic (EM) survey system called Louhi. It has two modes of operation – one uses a large loop on the ground as an EM source, while the other uses a small portable loop EM transmitter. Both systems utilize a lightweight three-component EM receiver towed by a drone.

Second, DTU Space is developing a drone-based gravity system with a moving platform. The goal is to make the operation feasible by exploring new sensor systems. A new configuration called the strap-down configuration of an inertial measurement unit (IMU) has many advantages over traditional gravity sensors. The IMU is physically fixed to the chassis of the aircraft, making it simpler, smaller, lighter, and requiring less power.

Third, self organizing maps (SOM) method have proven in the past to be applicable for geoscientific data integration and mineral prospectivity analysis. In DroneSOM, software tools for implementation of SOM were developed by Geological Survey of Finland and Beak Consultants. One developed tool is the open source standalone application GisSOM for mineral predictive mapping (MPM) in 2D, while the other currently developed option is advangeo® Prediction, which will allow MPM in 3D using SOM.