

Using Unmanned Aerial Vehicles (UAV) for Geomagnetic Referencing

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MagVAR In-Field Referencing (IFR) improves well placement accuracy in directional drilling by providing a comprehensive 3D geomagnetic reference model for real-time steering. The large-scale features of the IFR model are determined from satellite magnetic measurements while the small scale-features are resolved using local surveys by aircraft or ship. As an additional option, MagVAR partners with Schlumberger to [map local magnetic anomalies and monitor disturbance fields](#) using autonomous marine vehicles.



Figure 1: GEM System's magnetic gradiometer UAV

A new opportunity has arisen with the recent improvements in surveying by unmanned aerial vehicles. UAVs are already widely used for local small-scale magnetic surveys as an alternative to conducting ground magnetic surveys by foot. Such applications are limited in spatial extent due to government “line of sight” rules and the limited range of small to mid size UAVs. For example, GEM Systems offers their Monarch Unmanned Fixed Wing Magnetic Gradiometer (Figure 1) with an endurance of 1-2 hours. The advent of mid-size UAVs with much larger ranges, combined with regulatory changes making it easier to obtain permission for “beyond sight” flights, offer the opportunity to survey larger areas efficiently by UAV. The measurements are collected as in conventional airborne magnetic surveys by flying a regular mesh with main lines and tie lines. The data on the main lines are then leveled against the tie lines and interpolated to a regular grid, which can be either at a constant terrain clearance or at a constant barometric altitude.

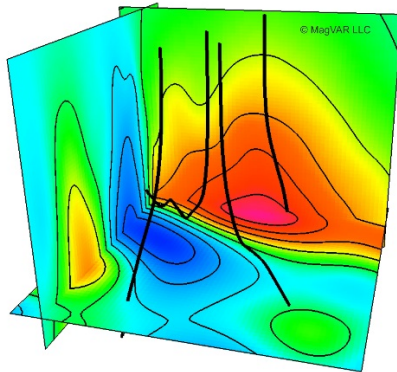


Figure 2: IFR model enabling accurate steering while drilling

The local survey with dimensions of the order of 80 km x 80 km is then merged with regional data to extend the spatial coverage before tying it into a global magnetic anomaly grid derived from satellite data. This merger creates a global magnetic grid with locally enhanced resolution. MagVAR’s method of representing a global magnetic grid by expanding the potential into ellipsoidal harmonics provides by far the most accurate representation of the magnetic field over the entire wavelength spectrum.

Once the magnetic potential is available in terms of its ellipsoidal harmonic coefficients, the direction and strength of the magnetic field can be synthesized above and below the Earth surface, as long as we stay above the sources of the magnetic anomalies. MagVAR provides IFR software to query the resulting 3D magnetic model (Figure 2) and use this information for downhole navigation in directional drilling.

For further information, visit our website at <https://www.magvar.com/>, contact us by email at maginfo@magvar.com or call us at +1- (303) 539-6986.