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Selecting an Overhauser Magnetometer/Gradiometer: Points to Remember

Overhauser magnetometers take advantage of key phenomena – the ability to use radio frequency (RF) signals to excite both protons and free electrons contained in a mixture of proton-rich solvent and free radicals.

When excited, the electrons add their net (higher) polarization to that of protons which results in precession signal to noise increased by approximately 5000 times. The effect is very high sensitivity with low power consumption.

When choosing an Overhauser magnetometer for your application, it is important that you identify:

1. What type of unit do I need – Rover or Base?

- A Base Station operates in stationary mode measuring temporal or diurnal variation of magnetic field. Rover measures both temporal and spatial changes. Subtracting Base Station variations from Rover variations leaves clean spatial ones. However, it is also possible to conduct field surveys with just a Rover. You can do it by re-occupying selected stations periodically through the survey and use them to establish diurnal corrections.

- For airborne operations, Overhauser in portable mode is available in base station configuration. Overhauser offers adequate low noise and high speed for airborne diurnal corrections or just monitoring of diurnal magnetic activities.

2. What type of sampling best meets my requirements? – Continuous or Discrete

- Overhauser offers both ‘walking’ (i.e. nearly continuous) and ‘mobile’ (i.e. discrete or standard) survey operations.

- Overhauser sample rates (i.e. maximum of 5 sample every 1 second) are higher than for Proton Precession magnetometers and gradiometers (maximum of 2 sample every 1 second)

- Sample rate of 5 Hz is more than adequate for most ground surveys. It also enables you to perform vehicular surveys over various types of surfaces (ex. snow or regular ground) as needed.

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3. What should I expect in terms of data quality?

- The Overhauser magnetometer / gradiometer has a number of built-in features that ensure high data quality. These include sensor design and processing algorithms.

- These systems also have negligible heading error (terms of pT). In comparison, Optically Pumped Caesium systems can have 2 nT heading error or more.

4. What sensitivities are appropriate?

- When considering sensitivity of systems, it is important to remember that Overhauser has, in general, higher sensitivities than Proton Precession and similar sensitivities to Caesium, and is available at considerably lower cost.

- Sensitivities for Overhauser are of the order of 0.02 pT / √Hz for Standard (i.e. mobile) mode at 0.33 Hz and for Walking mode at 1 Hz

5. What are the power requirements and operating characteristics?

- GSM-19 Overhauser has the lowest power consumption of all scalar magnetometers; a consideration that is important for daily productivity and operator convenience.

- Power consumption can be as low as 1W for 'walking' operation.

- There is no warm-up time in contrast to Optically Pumped devices which translates into faster survey initiation. Overhauser magnetometers operate in either pulsed or continuous modes. With pulsed modes, the sensor can be shut down between the readings to save power. With continuously reading magnetometers, power consumption is still minimized and only a few watts are required to operate the system.

6. What GPS options should I consider – Time and Position?

Here are the options available for GEM Systems Magnetometers:

- Option A Internal GPS for stationary (i.e. base station) applications, time-only GPS is appropriate for synchronizing to the rover prior to survey initiation.

- Option B Internal GPS for "walking, mobile or base station" surveys, <1.5m resolution, built-in DGPS with SBAS (WAAS / EGNOS / MSAS)

- Option C External GPS for "walking, mobile or base station" surveys, <1m resolution, external DGPS with SBAS or international subscriber services - OmniSTAR or Thales (Racal)

- Option D Internal GPS for "walking, mobile or base station" surveys,
  <0.7m resolution, built-in CDGPS
  <1m resolution, built-in DGPS using OmniSTAR subscription
  <1.2m resolution, built-in DGPS with SBAS (WAAS / EGNOS / MSAS)

- It is also feasible to interface to a customer-supplied GPS on a custom basis. For details, please contact GEM.

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7. Advantages of Magnetic Gradiometers?

- Gradiometers have shown that they can offer a high degree of immunity from diurnals and minor magnetic storms. They can enhance near-surface, small or weak magnetic anomalies and provide obvious improvements in spatial resolution over the total field measurement alone.

- A gradiometer is ideal for locating small, near surface anomalies. Therefore it's very useful in archeological, geotechnical and environmental mapping. Also a vertical gradiometer may be deployed without a base station magnetometer, as gradient of the magnetic field is normally free of diurnal variations.

- One of the sensors used for the gradient measurement also can be used to obtain total field data - providing a complete set of data for analysis and interpretation.

8. What are the conditions for operating the magnetometer / gradiometer?

- Overhauser features high gradient tolerance for efficient operation in the vicinity of magnetic rocks or cultural artifacts. Overhauser' signals are stronger and take longer to decay, hence the signals are easier to read in regions of high magnetic gradients.

- Environmental parameters for the GSM-19 Overhauser magnetometer and gradiometer include operation between -40 and +50 degrees Celsius.

9. What if I have more questions?

GEM is more than happy to answer your specific technical or other questions regarding its families of Overhauser, Optically Pumped Potassium and Proton Precession units. Please feel free to send an email to info@gemsys.ca or visit www.gemsys.ca for more details on the products and capabilities in which you are most interested.