GEM Advanced Magnetometers
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Selecting an Overhauser Magnetometer: Points to Remember

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

When excited, the electrons add their net (higher) energy to that of protons with the result that signal to noise is increased by approximately 5000 times. The result is very high quality results 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

- For normal ground operations, a rover and a base station are required for drift corrections. However, it is also possible to conduct field operations with just a rover by re-occupying selected stations repeatedly through the survey and using these to establish drift corrections.

- For airborne operations, Overhauser is available in base station configuration. Overhauser offers one of the lowest-noise, high accuracy systems available.

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. 5 Hz) are higher than for Proton Precession magnetometers and gradiometers (i.e. maximum of 1 sample every 3 seconds)

- Sample rates almost match Optically Pumped Caesium systems (i.e. 5 Hz compared with 10 Hz. 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 and gradiometer has a number of built-in features that ensure high data quality. These include sensor design and processing algorithms.

- These systems also have minimal heading error. In comparison, Optically Pumped Caesium systems can have up to 2 nT heading error. Overhauser has one relatively narrow spectral line which minimizes heading error. In contrast, Caesium systems use "lumped" spectra to reduce errors due to changes in coupling angle with the ambient magnetic field.

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 lower cost than Caesium.

- Sensitivities for Overhauser are on the order of 0.015 pT / √Hz for Standard (i.e. mobile) mode at 0.33 Hz (discrete) and for Walking mode at 1 Hz. This is comparable to Caesium at this sample interval.

5. What are the power requirements and operating characteristics?

- The GSM-19 Overhauser has the lowest power consumption in comparison with Proton and Optically Pumped systems; a consideration that is important for daily productivity and operator convenience.

  Power consumption is as low as 1W for "walking" operation. The reason is that RF polarization requires less power than the DC current used for polarization in Proton Precession, and is less power hungry than Optically Pumped magnetometers and gradiometers which require dedicated heating circuits, etc.

- There is no warm-up time in contrast with 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 to save power. With continuous reading magnetometers, power consumption is still minimized as only a few watts are required to operate the system.

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

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

- For "walking" or "mobile" surveys, GPS is available to several levels of precision. <1.5 m circular error probability is standard for most units which feature an internal GPS. Higher levels of precision can also be provided using an external GPS (or using post-processing algorithms that are available commercially).

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

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

- The Overhauser features higher gradient tolerance than Proton Precession systems 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 Celcius.

8. 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.