GEM Advanced Maqnetometers
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Maximizing Magnetometer Signal Strength

In some ways, magnetometers are like radios. With a radio, for example, you can use an auto-search function to find a radio station and stay set on that station. Similarly, advanced magnetometers also provide you with an "auto-search" or scan feature for finding magnetic field frequencies and locking on the applicable one (i.e. corresponding to the magnetic field at a specific location).

On the other hand, magnetometers are also a little different from radios because the magnetic field and hence, frequencies change dynamically with position. To help obtain high quality readings, magnetometers have a second function called "auto-tune" that tracks the field and helps to maximize the signal-to-noise ratio.

With an advanced magnetometer, there will be some sort of "tune initialize" function that is responsible for finding the precession signal (ex. similar to a radio station), and a second "auto-tune" function that tracks the precession signal as it changes in amplitude. This short report provides an overview of functions available with advanced magnetometers and how you can use these to your advantage.

Case 1: Standard Magnetometer Settings (Yes, Yes)

With this case, "tune initialize" is set to YES and "auto-tune" is set to YES. The "tune initialize" value enables the magnetometer to scan the entire range of frequencies (say, from 20,000 to 90,000 nT), and to find the signal (ex. 37,000 nT). Hence, the magnetometer has found its correct "radio station".

The role of the "auto-tune" function is to enable the magnetometer to follow changes in the magnetic field. For example, if the field jumps by 10,000 nT to 47,000 nT, the magnetometer will smoothly follow the signal and hence, maximize the signal-to-noise ratio.

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This group of settings is recommended for use when 1) the average magnetic field value at the survey location is not known or alternately, 2) as a default for maximizing signal-to-noise ratios.

Case 2: Recovering from Magnetic Noise (Yes, No)

With this case, "tune intialize" is set to Yes and "auto tune" is set to No. The "tune initialize" value enables the magnetometer to scan the entire range of frequencies (say, from 20,000 to 90,000 nT), and to find the signal (ex. 37,000 nT). Hence, the magnetometer has found its correct "radio station".

With the "auto-tune" set to No, the magnetometer records values that are within a certain range of the tune initialize value. If values go outside of this range (ex. 47,000 or 28,000), the resulting magnetic recordings reported will all be zero.

This group of settings is recommended for use when the magnetometer is running automatically (ex. as a base station) and there is some magnetic noise in the vicinity, for example, from vehicles nearby. The magnetometer may lose its signal when these extreme noise events occur; however, it will recover gracefully as it will use the "tune initialize" value for readings that follow.

Case 3: Obtaining Fastest Readings (No, Yes)

With this case, "tune initialize" is set to No and "auto tune" is set to Yes. The "tune intialize" value turns the scanning off so that the magnetometer does not search over the range of frequencies. An initial tuning value is set manually.

Meanwhile, the "auto tune" value ensures that the magnetometer will follow all changes in the magnetic field; hence, obtaining an accurate measurement.

This group of settings is recommended for fastest readings; reading time is minimized as the system will not scan over the entire frequency range (i.e. disabled). In addition, it is recommended for areas with very high gradients; the magnetometer may saturate at

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these points but will recover gracefully once the magnetometer passes by anomalous zones. Another possible use is with a base station where the unit is stationary and the base unit does not have to handle large deviations in values such as would be encountered in a moving survey.

Case 4: Disabling Tuning Functions (No, No)

With this case, "tune initialize" is set to NO and "auto-tune" is set to NO. Hence, the magnetometer tuning is disabled and no scanning or tracking of the field will occur. An initial tuning value is set manually.

This group of settings is recommended only for use with a base station (i.e. where the unit is stationary and not affected by large survey-related jumps in the magnetic field.

Summary

In summary, we can see that magnetometers resemble radios, at least, in part due to the necessity to tune them (i.e. tune-initialize). However, the similarities end here as a second function is provided for tracking dynamic changes in the magnetic field (i.e. auto-tune). There are four possible settings for the combinations of these two parameters – each of which has different advantages or roles.

The most common setting is "tune initialize" is YES and "auto tune" is YES; the magnetometer will both find the local field value and also track any changes. The next most common setting is "tune initialize" is NO and "auto tune" is YES. With this setting, the user specifies a value for the local field and the magnetometer will track changes automatically. The latter two settings are special cases that may be used with base stations or other circumstances as described previously.

The bottom line in considering these settings is that they enable you to minimize noise, recover gracefully from high gradients, operate base stations effectively, and make readings as quickly as possible – all valuable capabilities for users of advanced magnetometers.