Working with the Bartington Fluxgate Gradiometer

Operating the Mag in the Field

About the Instrument

The Bartington Fluxgate Gradiometer, colloquially known as a "magnetometer" or "mag," measures the variations in the magnetic field caused by anomalies in the ground. With two sensors on the left and right of the machine, these sensors have two coils of wire in it, generating a magnetic field at the top and detecting the field from the bottom. The magnetometer removes the background magnetic field from the sensors, allowing for a closed system that can get a full reading of what's under the surface. Because it is sensing for ferrous (iron- or steel-based) metals, it's important to ensure that you have no metal on you that may include iron/steel.

Equipment Components

- Large briefcase
- Two sensors (poles)
- Backpack
- Data logger, battery, and holder (all in one)
- Flash Drive
- Charger cord
- Mag to computer dongle
- Four metal-less tape measures
- PVC flags
- Emlids (base and rover) and two poles

Working with the Gradiometer

Before Going into the Field

1. Make sure to charge the Mag the night before you plan to use it
2. Gather your field equipment:
    a. The magnetometer (in the case), including the backpack, two poles, and the mag itself
    b. PVC flags
    c. Metalless tape measures
    d. Emlid system with poles
3. Prepare your metalless outfit for running the magnetometer
    a. Be sure to have backup options in case something unexpectedly has metal in it (especially shoes)
    b. Plan to wear no jewelry, nothing with zippers, and a sports bra without metal if applicable
    c. Ensuring that you have no metal on your body is key to working the Mag properly

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Initial Set Up

1. Turn on the magnetometer and allow to warm up for 10-15 minutes
2. While the Mag is warming up, set up your grids using the metalless tape.
    a. For easy access, here are the square roots for each type of grid for your diagonal line:
        i. 10x10: 14.14
        ii. 20x20: 28.28
        iii. 30x30: 42.43
3. Using the emlids, take high accuracy points on each corner of your grid
4. Remove any extra metal from the person running the mag and put on the mag backpack
5. Turn on the magnetometer. Hit “Grid.”
6. Scroll down to Start Scan and click enter. Now you can test yourself and your items to ensure that they are metal free.
    a. Watch the numbers on the screen and bring your items close to the left or right sensor. Your items should not change the numbers dramatically on the sensor.
7. Now you need to find a spot to calibrate the Mag:
    a. Moving left-right and back and forth, look for an area that has relatively low change in metallic frequency (less than ten units changing)
8. Once you have found a location ideal for calibration, you can calibrate the Mag

Calibration

1. Using a compass, place non-metal stakes to mark out North, South, East, and West in reference to a metal-free stool placed in the center.
2. Give your partner the compass or place the compass away from the person running the Mag
3. On the Mag’s main screen, click on “Adjust Gradiometer” and follow instructions on the screen
    a. After clicking “Enter” on each screen prompt, wait for the Mag to beep and a new prompt to appear on the screen.
    b. When the Mag asks you to invert it, simply flip the device using the handles and click the green button to collect the data.
4. When the screen says that the calibration is complete, you are ready to start scanning!

Scanning

1. Since you have already set up your grids, you are ready to scan!
2. Make sure you have removed all metal from yourself, and then position yourself next to your starting line.
3. Check the Mag settings:
    a. Pace: start slower (0.8 m/s) for practice, and then as you get more comfortable with the machine, switch to a faster pace that works best for you
    b. Grid Size: obviously match the size of the grid you are working on
    c. Start: choose the direction you are starting with (North usually)

   d. Pattern: Zig-zag is typical, but change depending on your planned path
   e. Lines/m: stick with 2 (½ meter spacing on the horizontal axis)
   f. Samples/m: we usually use 8, but choose the amount of data you'd like to receive
   g. Range: maximum that the gradiometer will measure, we usually use 100 unless you're in an area with more metal
   h. Audio: On/Off
   i. Volume: Low/Medium/High
   j. Threshold: 1 nT
   k. Sensors: 2 (duh)
   l. Hit save!
4. Stand at the 0.75m mark on your tape, so that one pole is at 0.25 m and the other is at 1.25m.
5. The machine will beep at every meter you walk, so ensure that your pace is matching the beeps as you cross each meter. Thus, for a 10x10m grid, you're expecting 10 beeps; for a 20x20m grid, 20 beeps; and so on and so forth. I recommend doing a couple practice walks first to ensure that you are matching the correct pace, and then once you get comfortable with that, start actually collecting data.
   a. If you do these practice walks, make sure to delete the data and restart from the correct orientation to not mess up the viable data. You can retake data as many times as you need.
6. The first beep will count as "0" in your head, and you should be crossing the line as the first beep happens.
7. At the end, it will do a double beep to tell you that you hit all 10 meters. You should be crossing over the second tape at this point
8. Once you have collected the first line of data, move over one meter and continue scanning on the next grouping.