SPH Engineering

MagNIMBUS

Airborne magnetometer system powered by QuSpin QTFM Gen-2 sensors

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MagNIMBUS

Ultra-sensitive airborne integrated magnetometer system powered by QuSpin QTFM Gen-2 atomic total-field magnetometer sensors

Image: MagNIMBUS in gradiometer configuration in flight

Typical applications are:

- Searching for UXO (unexploded ordnance) and landmines in metallic casings
- Tramp metals and lost GET (ground engagement tools) detection
- Locating buried infrastructure (metal pipes, shielded cables, power cables under load)
- Environmental surveys for abandoned wells, pipes, and storage tanks quickly and with precise positioning
- Geology and minerals prospecting: surveys for regional variations in the magnetic field
- Archaeology

The unique system design allows the drone to fly with extremely low surface-to-sensor clearance, starting from just a few dozen centimeters. If the sensor touches the ground or an obstacle/vegetation, this will not cause the drone to crash. This capability is extremely important when searching for small UXO items in fields with vegetation.

The self-foldable sensor mount allows easy take-off and landing without the additional operator-qualification requirements that apply to magnetic sensors on suspension cords.

Main components of the system:

- Recommended drone: DJI M400, M350, or M300 RTK. Standard kit comes with all mountings/cables for these drones, sets for other types of drones, including Pixhawk-based, are available by request.
- Foldable mount with built-in QuSpin QTFM Gen-2 magnetic field sensor.
- Mast with QuSpin QTFM Gen-2 sensor for gradiometer configuration.
- SkyHub onboard computer – acts as a datalogger for magnetic field sensors and implements a terrain-following mode for DJI drones.
- Altimeter (laser or radar).
- UgCS Expert flight planning/management software.

Recommended software for data processing:

- for in-field and quick processing: GeoHammer Pro
- for large-scale projects and complex processing: Seequent Oasis montaj

System variants

MagNIMBUS comes in two possible configurations:

- Gradiometer. This configuration simplifies data processing and makes it possible to perform magnetic surveys in proximity to sources of EM fields such as powerlines or railroads.
- Configuration with a single sensor on a foldable mount. Detection capabilities are the same as for the gradiometer setup, but it requires more experienced specialists for data processing; a magnetometer base station is recommended in some cases.

UXO/landmines detection note

The system is capable of detecting a range of items, from hand grenades (the estimated sensor-to-target distance for detecting a target such as the F1 hand grenade is 0.5 m) up to large UXO such as aerial bombs at a distance of several meters.

While the system is capable of detecting some types of landmines (M15, M6, TM-62M anti-tank mines; M16, PROM-1, OZM-3, OZM-4, OZM-72 anti-personnel mines and similar types with considerable amounts of ferrous metal), landmine search is not a direct application of the system, as it cannot detect most types of modern landmines. This means that the system should never be used to confirm the absence of landmines (and small UXO) in a given area, but it can be a valuable

asset during a Non-Technical Survey (NTS) or Technical Survey (TS) to confirm the presence of UXO/landmines that contain a considerable amount of ferrous metal.

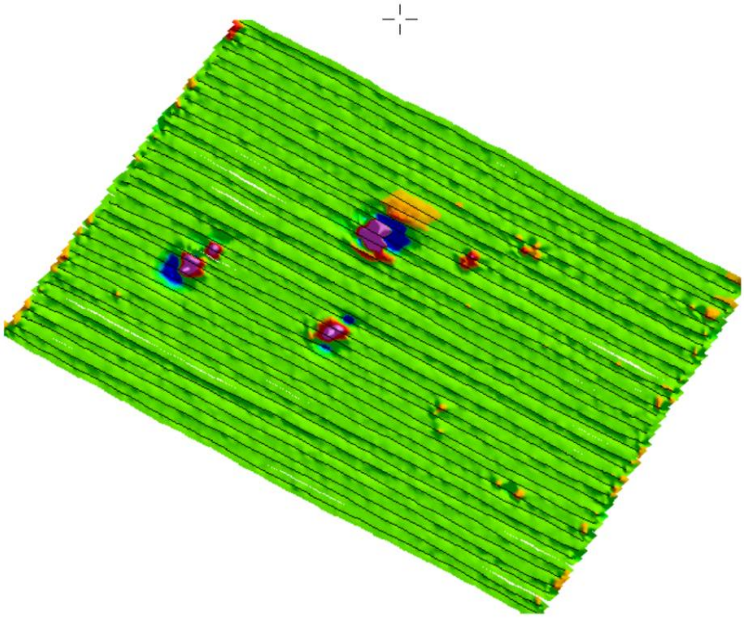

Image: Processed data from a survey of a former shooting range. Large anomalies are 72 mm and 150 mm artillery shells, as well as a short piece of metallic pipe. Small anomalies are metallic scrap (pieces of artillery shells, etc.). Vertical gradiometer data was processed in Geosoft Oasis montaj.

Utilities detection

The system is effective for locating metallic pipes and underground power cables under load.

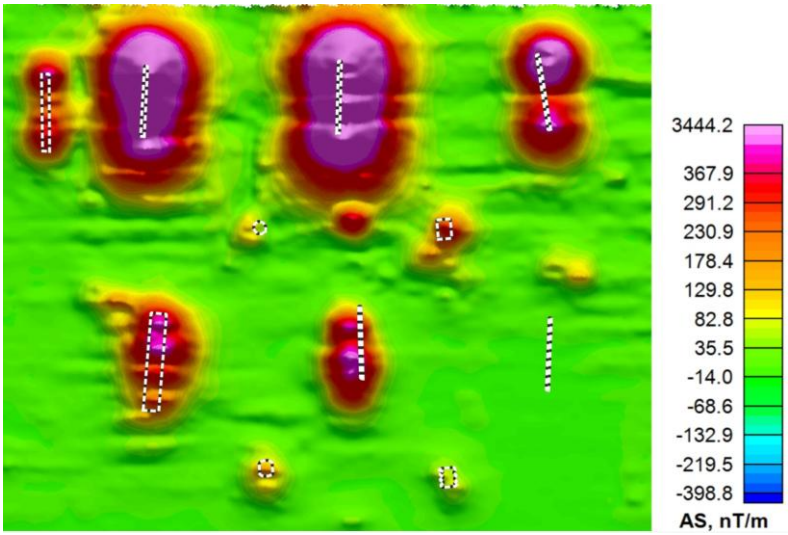

Image: processed data from a survey over SPH Engineering's own test range. Detected targets are reinforced concrete and metallic pipes as well as metallic barrels. Small anomalies are metallic scrap. More information about test range and targets.

Productivity of the data acquisition process

The time required to survey a given area depends on two main factors:

- Distance between survey lines
- Flight speed

For UXO search, the distance between survey lines depends on the types of expected items. For robust detection (across 2 parallel survey lines) of small items such as hand grenades or submunitions, it is recommended to keep the distance between lines as small as 0.5 m.

For larger items such as artillery/mortar shells, the optimal distance between lines is 1 m.

Flight speed should be determined by flight safety considerations and the type of terrain. For typical, non-rugged terrain such as farm fields, the recommended flight speed is 2–6 m/s. So, for the worst-case scenario (0.5 m separation between survey lines, 2 m/s survey speed), the time required to scan 1 ha can be estimated as follows:

Number of survey lines: 100/0.5 = 200 lines

Total length of survey lines: 200 * 100 = 20 000m

Additional length of perpendicular lines and fly-in/fly-out segments: 200m

Required flight time at 2m/s flight speed: 20200m / 2m/s = 10100s or 168 min.

For the DJI M350 RTK drone, flight time with the magnetometer system will be 30 minutes. Allowing for a 15-minute break between flights for battery changes, etc., the time required to survey 1 ha with 0.5 m between lines at 2 m/s flight speed will be approximately 4.5 hours. Using the same formulas, the flight time required to scan 1 ha with a line separation of 1 m at a speed of 6 m/s will be just 30 minutes.

Technical information and specifications

MagNIMBUS technical information can be found by the link.