New processing methods for data of a full tensor magnetic gradiometer system

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ABSTRACT

Advanced system calibration and data processing methods have to be developed for high sensitive magnetic measurements using the Full Tensor Magnetic Gradiometer (FTMG) system developed at the Institute of Photonic Technology (IPHT) Jena. The instrument consists of an array of six extremely sensitive gradiometers and a triple of orthogonal magnetometers based on low-temperature Superconducting Quantum Interference Devices (SQUIDs).

First we implemented in the semi-automatic processing scheme the calculation of the magnetic field component from the IGRF and developed the extension towards the gradient tensor components. The next step is to do a fast calibration of the magnetometer signals which compensates for scaling errors, misalignment, and also for arbitrary offsets introduced by the SQUID the read-out electronics using the IGRF.

In a subsequent step we have to compensate for the parasitic magnetometer areas of the gradiometers called balancing. They lead to a strong influence of motion noise in the tensor components. The calculated tensor components have to be transformed from the local system frame into an Earth-Centered, Earth-Fixed coordinate system.

Additional processing steps have are introduced which allow to convert between the magnetic signals. Hilbert and Hilbert-like transforms are used to transform between gradient tensor components, magnetic field vector components and total magnetic intensity (TMI). The processes are performed either in wavenumber or Fourier domain or in space domain by integral presentation. First results are shown and a comparison of the two transformation schemes discussed.

The transformations allow calculating low noise TMI and the magnetic field components from the gradient tensor components. Besides the improvement of magnetic resolution the mentioned transforms are used for calibration of the system components to and for comparison with data from other surveys. Example data are shown.

Key words: SQUID, magnetic field sensor, gradiometer, full tensor, data processing, calibration