OBSERVATORY AND FIELD TESTS OF LEMI-TYPE MAGNETOMETERS

B. Bondaruk, L. Rakhlin, V. Korepanov
(Lviv Centre of Institute of Space Research of NASU and NSAU, Lviv, Ukraine)
J. Marianiuk, J. Reda, A. Palka
(Central Geophysical Observatory of Geophysical Institute of PAS, Belsk, Poland)

The Earth's magnetic field study is still an actual problem of geophysics. The development of both scientific investigations and applied geophysical research needs more and more exact data of observatory and especially field monitoring of magnetic parameters.

The questions of high-class three-component flux-gate magnetometers development, tests and practical use are the subject of the collaboration between Central Geophysical Observatory of Geophysical Institute of PAS, Belsk, Poland, (Belsk Observatory) and Lviv Centre of Institute of Space Research of NASU and NSAU, Lviv, Ukraine (LCISR). During more than 5 years of such collaboration a considerable improvement of metrological parameters of LEMI-type magnetometers manufactured by LCISR was reached. Also Belsk Observatory not only continued to produce one of high-quality magnetic data, but also was equipped by modern installations and methodology what allows to execute all types of magnetometers tests: noise and long-term drift study, thermal factors determination, calibration etc.

If we were to grade the FGM parameters by their importance for geophysical need, the sequence will be following: long-term stability, noise level and temperature drift. All other FGM parameters are quite acceptable practically for any application and can be determined by certification. Both long-term stability and noise level are physically the same noise parameters, but in different time domains. In order to have the full impression about temporal noise dependence of the FGM following temporal band share was introduced:

0,1 s - 100 s - flicker noise (f-band);

1 m - 100 m - short-term noise (s-band);

1 h - 30 days - mean-term noise (m-band);

1 day - 365 days - long-term noise (l-band).

The special laboratory equipment developed and installed in LCISR allows to make detailed noise power tests in f-band. These tests particularly prove that LEMI magnetometers excellently suit for magnetic pulsation study, the frequencies of which are within f-band.

Both the s-band and m-band noises were tested at Belsk Observatory, the basic magnetometer of which is of torsion type (PSM). The magnetometers of this type are especially

good in mentioned temporal bands because of inherently low level of suspended magnet own oscillations if the temperature of the environment is strictly stabilized. In Belsk Observatory the temperature in reference magnetometer hut is maintained in the limits within ±0,1 centigrade. The resolution of registration unit was 30 pT/bit only and sampling was made once per second without averaging. Then the tested magnetometer s-band noise was estimated as the difference between output signals of X, Y, Z channels of LEMI and PSM. Special measures were taken in order to eliminate the time shift influence between the samplings of reference and tested magnetometers channels. The 10-minuts intervals were randomly chosen for tests in the day-time when the activity of Earth's magnetic field was relatively low.

The same methodology was used for m-band noise estimation. First the 30-seconds averaging of 1-second samples for each channel was made in the registration unit and then 2-minutes means plot was constructed.

The most complicated is the l-band noise investigation and not only because it needs very long time. In this time domain absolute measurements only can be the reference for noise calculation.

Absolute measurements are the most important operations of the observatory practice. The corresponding instrumentation precision highly determines the quality of the observatory standard and also allows to estimate the quality of the magnetometers used for Earth's magnetic field monitoring. It is known that recently the problem with these devices manufacturing appeared due to the production suspension of non-magnetic theodolites at Zeiss factory. That is why an attempt was made in LCISR to demagnetize a standard Russian 3T2KP theodolites as an opportunity. A set of absolute measurements were carried out at the Belsk observatory to test the 3T2KP-NM theodolite modified and equipped with one-component fluxgate magnetometer LEMI-203 by LCISR. The Zeiss-Jena 010B theodolite with a Polish made fluxgate magnetometer was used as the reference instrument for this comparison. Measurements with the two instruments were done one after the other.

The experience of observatory tests of different types of LEMI flux-gate magnetometers - one-component theodolite-mounted for absolute measurements and three-components for field survey - carried out in Belsk Observatory are discussed.