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Induction coil magnetometers – a review

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Induction coil magnetometers (IM) are widely used for the experimental study of natural and man-made magnetic fields variations in the frequency band from 0.0001 till 1000000 Hz for science and engineering application in land and space conditions. They are probably the most widespread devices used for the magnetic field study and the review of the existing versions of IM will be of interest for the users and designers. The existing information about IM used for different application was examined and following classification is proposed.
1. Low frequency IMs which operate in the frequency band from 0.0001 till 1000 Hz in land and underwater applications (LEMI-120, LEMI-121, LEMI-102S (by LC ISR), ANT/4 (by Zonge Engineering), MFS-06, MFS-07 (by Metronix), BF-4, BF-7 (by EMI))
2. High frequency IMs which operate from 10 Hz and higher for land applications (LEMI-118 (by LC ISR), ANT/6, ANT/5 (by Zonge Engineering), MFS-06, MFS-07 (by Metronix), BF-6, BF-10 (by EMI))
3. Specially designed IMs for using in space conditions (Bepi Colombo, CLUSTER, DOUBLE STAR, THEMIS, DEMETER, LEMI-106)
4. Time domain IMs (TEM/3 (by Zonge Engineering), LEMI-123 (by LC ISR))
5. IMs for special applications (super-low power, super-small, indicator etc) (LEMI-130, KM (by LC ISR)).
The overview of the construction and their design peculiarities is made. It is stated that despite of apparently simple IM construction – coil with the core and amplifier – the exact calculation procedure for IM optimization is not developed till now. The developed in LCISR design algorithm allowing calculation of the IM parameters to get optimal noise value for the given sensor length is presented. The peculiarities for the design of IMs for special applications (super-low power, super-short and super-light) are discussed.
In the conclusion, several interesting practical implementations are given and the comparison of the parameters of best IM within each group is made. A new comparison criterion is proposed – noise reduced to unitary length – which allows comparison of IMs with different length for given frequency range.