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A Magnetic Measurement System for Extracting Pseudo-Multipoles in Accelerator Magnets

For accelerator magnets such as capture solenoids, fragment separator dipoles and insertion quadrupoles, it is important to measure not only the integrated field errors but also the local field distributions in the magnet extremities. In three-dimensional field problems the transversal multipole coefficients do not constitute a complete orthogonal function set. This gives rise to pseudo-multipoles in Fourier-Bessel series that can also account for field variations in axial direction.

In the magnetic measurement section of CERN's TE department we have started to design, construct, and characterize metrologically a measurement bench composed of high precision mechanics with integrated real-time automatic control and drive system, encoders, and measurement transducers with iso-perimetric search coils. A suitable post-processing tool is being developed based on the theory of pseudo-multipoles as well as field reconstruction from boundary data.

Scientific challenges stem from the need to calculate higher-order derivatives of the measured flux densities, which in turn boosts the requirements of the data acquisition systems and digital integrators, as well as the mechanical stability of the bench and transport system. Other challenges stem from the coil design, which results in convoluted signals because of the non-negligible thickness and the short length of the search coils.

Summary

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