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Nonlinear simulations of the fast orbit corrector magnets for PETRA IV

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Fast orbit feedback systems are an important component in fourth-generation synchrotron radiation sources such as PETRA IV at DESY in Hamburg, Germany. These control systems are designed to stabilize the particle orbit, i.e., to correct deviations from the design orbit due to various disturbances. To that end, such a system employs fast orbit corrector magnets, which must be powered at frequencies up to the kilohertz range. This leads to significant eddy current effects that must be predicted via finite element simulations. Therefore, extensive simulation studies have already been conducted.
These simulations did not, however, consider the magnetization curve's nonlinearity since doing so requires prohibitive computational effort when using commercial software. Hence, we have constructed a dedicated method, based on a combination of the harmonic balance finite element method and homogenization schemes, to enable nonlinear simulations. This contribution outlines the general idea and application of our method to the corrector magnets of PETRA IV and presents the most important findings regarding the impact of the nonlinear magnetization curve on the magnet's performance.

Footnotes

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