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Efficient Nonlinear Simulations of Fast Corrector Magnets

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Fast orbit feedback systems are essential parts of fourth-generation synchrotron radiation sources. Their purpose is to keep the beam position under tight control by correcting for disturbances up to the kilohertz range. Simulating the electromagnetic fields in the fast corrector magnets at elevated frequencies is a challenging task: the laminated structure of the yokes and the low eddy-current skin depths necessitate a very fine mesh and a small time step. The computational cost can be decreased by using special homogenization techniques, but this comes with the assumption of a linear magnetization curve. To lift this limitation, we set up a simulation procedure combining such homogenization techniques with the harmonic balance finite element method, allowing us to perform efficient nonlinear simulations of the magnets without resolving the laminations by the mesh and without time-stepping. In this contribution, we give an overview of our linear simulation results for the fast corrector magnets of the new synchrotron radiation source PETRA IV at DESY and discuss the capabilities and limitations of the combined method for the nonlinear simulations.

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