Calculation of Transient Magnetic Fields Using Space-Time Adaptive Methods

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The discretization of transient magneto-dynamic field problems with geometric discretization schemes like the Finite Integration Technique or the Finite-Element Method based on Whitney form functions results in nonlinear differential-algebraic systems of equations of index 1. The efficient transient computation of magnetic fields in induced eddy current layers as well as in regions of ferromagnetic saturation that may appear or vanish depending on the external current excitation requires the adaptation of the finite element mesh at each time step. Hence, a combination of error controlled spatial adaptivity and an error controlled implicit Runge-Kutta scheme is used to reduce the number of unknowns for the algebraic problems effectively and to avoid unnecessary fine grid resolutions both in space and time. Prolongation and restriction operators are introduced to map the solution of the last time step to the actual time step.

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