Computational Electromagnetics III
Magneto-Mechanical Field Problems and Advanced Applications

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The transient behaviour of some magneto-mechanical system can be described by Maxwell's and Lamé's partial differential equations (PDEs) with appropriate coupling terms reflecting the interactions of these fields and with the corresponding boundary and initial conditions. Neglecting the displacement currents and introducing the vector potential for the magnetic field, we arrive at a system of parabolic PDEs for the vector potential coupled with the hyperbolic PDE system for the displacements. Usually the computational domain, the finite element discretization, the time integration, and the solver are different for the magnetic and mechanical parts. For instance, the vector potential is approximated by edge elements whereas the finite element discretization of the displacements is based on nodal elements on different meshes. The most time consuming modules in the solution procedure are the solvers for both the magnetic and the mechanical finite element equations arizing in each step of the time integration procedure. We present geometrical multigrid solvers that are different for both parts. These multigrid solvers enable us to solve quite efficiently not only academic test problems, but also transient 3D technical magneto-mechanical systems of high complexity such as magnetic valves and electro-magnetic-acoustic-transducers.

The visualization of the results of multifield computations is a very important issue in scientific computing and especially in electrical engineering. We developed the vizualisation tool VIPP that allows us to use advanced visualization equipment such as the CAVE.

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