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TIME INTEGRATION IN THE EXTENDED FINITE ELEMENT METHOD (XFEM)

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ABSTRACT

The extended finite element method (XFEM) [1] is frequently used in order to capture jumps and kinks within elements. Often, the position of these discontinuities changes in time as e.g. in crack propagation, two-fluid flows etc. The shape functions used in the XFEM depend on the position of the moving discontinuities and are, therefore, inherently time-dependent. That is, although XFEM simulations are typically carried out on fixed meshes throughout the simulation, the shape functions change in time.

Standard time-stepping schemes do not take this time-dependency into account, as e.g. noted in [2]. However, we found that for many situations, especially for moving *weak* discontinuities, where field quantities have a kink, time-stepping schemes are still a good choice and achieve nearly optimal convergence. The situation is different for moving *strong* discontinuities, where field quantities jump. Then, time-stepping schemes often reduce to first-order accuracy and space-time finite elements are a good choice for optimal convergence. Numerical results are shown for different time discretization methods in instationary one and two-dimensional applications involving moving discontinuities.

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