ADI scheme for partially dimension reduced heat conduction models

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In this talk, an alternating direction implicit (ADI) type finite volume numerical scheme is proposed to solve a non-classical non-stationary heat conduction problem set in a 3D tube with radial symmetry. The original 3D model is reduced to a hybrid dimension model in a large part of the domain. Special junction conditions are defined between 3D and 1D parts. The finite volume method is applied to approximate spatial differential operators and ADI splitting is used for time integration. The ADI scheme is unconditionally stable and under a mix of Dirichlet and Neumann boundary conditions the approximation error is of second order in space and time. An efficient factorization algorithm is presented to solve the obtained systems of equations. Results of computational experiments confirm the theoretical error analysis. Visual representations and computational times are compared for various sizes of reduced dimension zones, thus contributing to a conclusion that hybrid mathematical models can be used to simulate heat models for a quite broad set of domains and coefficients.

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