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Implementation of a Phase-Lagged Boundary Condition for Turbomachinery[1] ALEX WOUDEN, JOHN CIMBALA, BRYAN LEWIS, Pennsylvania State University — One factor that contributes significantly to the cost of a time-dependent CFD simulation is the size and scope of the computational domain. Common approximations, such as periodic and symmetric boundary conditions, have the advantage of reducing the domain proportional to its periodicity or symmetry. However, turbomachinery applications featuring multiple blade rows render the periodic boundary condition unphysical because the adjacent blade rows are designed with dissimilar blade counts. Though the meshes of adjacent blade rows can be modeled independently and data can be interpolated across a grid interface, applying the standard periodic definition to the coupled faces leads to an over-constrained situation: a failure to reconcile two governing relations imposed on the same cell. A phase-lagged boundary condition (PLBC) relaxes the over-constraint problem and provides a more correct assumption for the resulting flow field. PLBC is available in a limited number of private CFD codes and is only briefly documented in the literature. The present work expands upon its development by implementing PLBC in OpenFOAM®, an open-source CFD software package. Its performance is demonstrated for basic turbomachinery applications through comparisons with full-wheel simulation.

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