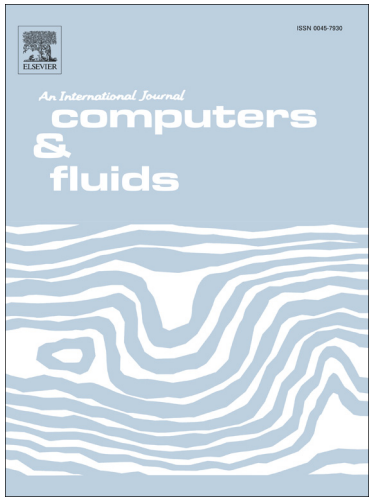

A sliding characteristic interface condition for direct numerical simulations

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A sliding characteristic interface condition for direct numerical simulations.

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Abstract

A characteristic interface condition serves as the basis for a novel sliding grid method, with a view to solving the compressible Navier-Stokes equations on block-structured grids that are delimited by boundary conditions in motion relative to each other. This requires that the convective and source terms of the equations in characteristic form be transformed to the reference frame of the neighbouring block, and interpolated. The method facilitates accurate interpolation at the interface, because the characteristic interface condition requires only a single layer of halo nodes. When a homogeneous direction is present, only 1-D interpolation is required, and schemes that might otherwise be too costly become affordable. The treatment also enjoys the same advantages as fixed characteristic interfaces do in relation to tolerance of grid discontinuities at block interfaces. The implementation and parallelisation of this method in a simulation code is described, and accuracy and performance demonstrated on a selection of test cases.

Keywords: Compressible Navier-Stokes equations, Characteristic interface conditions, Sliding grids, Parallel computing

1. Introduction

Sliding grids are a natural solution to some of the problems of simulating unsteady turbomachinery flows [7, 21], as well as simulations of rotorcraft [25], moving control surfaces [6], and stirred-tank reactors [38]. This approach makes it possible to discretise the flow around each body in the

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