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LOW MACH PRECONDITIONED NON-REFLECTING BOUNDARY CONDITIONS FOR THE HARMONIC BALANCE SOLVER

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In computational fluid dynamics (CFD), unsteady computations are cost intensive. For time-periodic flows, computational cost can be reduced considerably by recasting the governing equations in the Fourier domain, which results in the harmonic balance method [1].

In the low Mach regime, density-based solvers typically show slow convergence and inaccurate results. Low Mach preconditioning is a common approach used to remedy these issues [2]. It equalizes the characteristic speeds in the governing equations, which improves the convergence.

This paper presents the application of low Mach preconditioning of an existing harmonic balance method with special emphasis on the non-reflecting boundary conditions. Inlet and outlet boundary conditions may have a crucial impact on the flow inside the truncated computational domains used in CFD since improper boundary conditions can reflect waves exiting the computational domain. Non-reflecting boundary conditions [3], however, avoid spurious reflections. We explain how, for low Mach preconditioning, the formulation of the boundary conditions in terms of characteristics has to be adapted. An academic wave propagation test case is computed for different wave configurations to analyze the preconditioned boundary conditions.

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