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Computational Framework for a Fully-Coupled, Collocated-Arrangement Flow Solver Applicable at all Speeds[1] CHENG-NIAN XIAO, FABIAN DENNER, BEREND VAN WACHEM, Imperial College London — A pressure-based Navier-Stokes solver which is applicable to fluid flow problems of a wide range of speeds is presented. The novel solver is based on collocated variable arrangement and uses a modified Rhie-Chow interpolation method to assure implicit pressure-velocity coupling. A Mach number biased modification to the continuity equation as well as coupling of flow and thermodynamic variables via an energy equation and equation of state enable the simulation of compressible flows belonging to transonic or supersonic Mach number regimes. The flow equation systems are all solved simultaneously, thus guaranteeing strong coupling between pressure and velocity at each iteration step. Shock-capturing is accomplished via nonlinear spatial discretisation schemes which adaptively apply an appropriate blending of first-order upwind and second-order central schemes depending on the local smoothness of the flow field. A selection of standard test problems will be presented to demonstrate the solvers capability of handling incompressible as well as compressible flow fields of vastly different speed regimes on structured as well as unstructured meshes.

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