

An Axisymmetric Finite Element Method for Compressible Swirling Flow

Authors : Raphael Zanella, Todd A. Oliver, Karl W. Schulz

Abstract : This work deals with the finite element approximation of axisymmetric compressible flows with swirl velocity. We are interested in problems where the flow, while weakly dependent on the azimuthal coordinate, may have a strong azimuthal velocity component. We describe the approximation of the compressible Navier-Stokes equations with H1-conformal spaces of axisymmetric functions. The weak formulation is implemented in a C++ solver with explicit time marching. The code is first verified with a convergence test on a manufactured solution. The verification is completed by comparing the numerical and analytical solutions in a Poiseuille flow case and a Taylor-Couette flow case. The code is finally applied to the problem of a swirling subsonic air flow in a plasma torch geometry.

Keywords : axisymmetric problem, compressible Navier-Stokes equations, continuous finite elements, swirling flow

Conference Title : ICAFEM 2022 : International Conference on Advanced Finite Element Methods

Conference Location : Zurich, Switzerland

Conference Dates : January 14-15, 2022