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DEVELOPMENT OF A DISCONTINUOUS GALERKIN SOLVER FOR THE SIMULATION OF TURBINE STAGES

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In this work the capabilities of a high-order Discontinuous Galerkin (DG) method applied to the computation of the flow through turbine stages are investigated. The Reynolds averaged Navier–Stokes equations coupled with the two equations k-log(ω) turbulence model are solved to predict the flow features in a multi reference frame, where interfaces between fixed and rotating zones are treated with a mixing plane approach, and non reflecting boundary conditions are used [1]. To ensure, by design, the positivity of all thermodynamic variables at a discrete level, a set of primitive variables based on pressure and temperature logarithms is used. The fluid can be modeled with the polytropic, i.e., with constant specific heats, ideal gas law and the Peng-Robinson-Stryjek-Vera cubic equation of state (EoS).

Two different test cases are considered to validate the solver: the ERCOFTAC Test case 6 [2], i.e., the Aachen 1-1/2 stage turbine (operated with air as working fluid), and an ORC turbine (2 stages operated with the Siloxane MDM as working fluid), whose geometry is provided by Turboden. The influence on the solution accuracy of coarse grids, of the degree of the polynomial approximation and of the adopted thermodynamic model are investigated by comparing the results with experimental and numerical data available in the literature.

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