

The Open-source turboSU2 Solver for Non-ideal Compressible-fluid Dynamics

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Abstract

The capabilities of the open source SU2 software suite for the numerical simulation of viscous flows over unstructured grid are extended to non-ideal compressible-fluid dynamics (NICFD). A built-in thermodynamic library is included to account for the complex, non-ideal fluid thermodynamics in the close proximity of the liquid-vapour saturation curve and critical point. The numerical solvers, including Approximate Riemann Solvers (ARS) and boundary conditions, are generalised to non-ideal fluid properties. In particular, a non-ideal fluid version of the standard Roe and HLLC are presented and verified against analytical solution of reference NICFD test cases, including steady shock reflection in two spatial dimensions. Numerical application regarding non-ideal compressible-fluid flows around turbine blade, typical of Organic Rankine Cycle application, are presented and discussed. The present turboSU2 solver delivers a comparable accuracy and computational efficiency with respect to existing computation fluid dynamics (CFD) solvers and it is presented here as an open platform for the analysis and the automatic design of machinery operating in the non-ideal compressible-fluid regime.

References

1. I.F. PALACIOS AND M. R. COLONNO AND A. C. ARANAKE AND A. CAMPOS AND S. R. COPELAND AND T. D. ECONOMON AND A. K. LONKAR AND T. W. LUKACZYK AND T. W. R. TAYLOR AND J. J. ALONSO. Stanford University Unstructured (SU2): An open-source integrated computational environment for multi-physics simulation and design.. AIAA Paper 2013-0287, 51st AIAA Aerospace Sciences Meeting and Exhibit, January 2013..