Steady and Unsteady Turbulent Flow in External Aerodynamics

Petr Furmánek*, Jiří Fürst† and Karel Kozel†

*Aeronautical Research and Test Institute,
Beranových 130, 199 05 Praha - Letňany
petr.furmanek@gmail.com

†Czech Technical University in Prague
Faculty of Mechanical engineering
Department of Technical Mathematics
Karlovo náměstí 13, 121 35 - Praha 2
jiri.furst@fs.cvut.cz, karel.kozel@fs.cvut.cz

Keywords: ALE, FVM, Unsteady Flow, Turbulence Modelling, Spalart-Allmaras, TVD, WLSQR, SST.

Abstract The aim of this work is to summarize results of numerical simulations of steady and unsteady transonic flow obtained by two different modern finite volume schemes in combination with Arbitrary Lagrangian-Eulerian method (computation on moving meshes) and various models of turbulence. The simulations were carried out both in 2D and 3D and the unsteady effects were presented by forced oscillations of the profile/wing around given reference point/axis. Implemented schemes were the so called Modified Causon's scheme (based on TVD form of classical MacCormack scheme) and implicit WLSQR scheme (based on the WENO approach) combined with AUSMPW+ numerical flux in 2D and HLLC flux in 3D. As a 2D test case both inviscid and turbulent flow around the NACA 0012 profile wing have been simulated and the numerical results have been compared with experimental data. Both schemes were extended also for the 3D steady computations and tested on the transonic flow around the ONERA M6 wing. The computational area was discretized with two different types of finite volume meshes (H and C type). Comparison of the numerical results (both in-between and with experimental data) is satisfactory. Used turbulence models were: Spalart-Allmaras model, Kok's TNT model and SST k-ω model. The Modified Causon's scheme in 3D form was also adapted for unsteady computation with the use of ALE method and was tested on inviscid transonic flow around the ONERA M6 wing (forced oscillation around a given axis). Experimental data for this case are unfortunately not available. However, the numerical results show all the characteristics as expected.

Registration Information

- **Contact and e-mail address**: Czech Technical University in Prague, Faculty of Mechanical Engineering. Department of Technical Mathematics, Karlovo náměstí 13, 121 35 - Praha 2. e-mail: petr.furmanek@gmail.com
- **Period of Stay:** August 30 - September 4.
- **Accomodation Facilities:** Only in Telč.
- **Room Sharing in Telč:**
- **Type of Contribution:** Oral presentation.
- **Abstract:** see page 1.