RESIDUAL DISTRIBUTION SCHEMES FOR 3D TURBULENT FLOWS ORIENTED ON AUTOMOTIVE APPLICATIONS

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This PhD project is shared between von Kármán Institute and Faculty of Mechanical Engineering at Czech Technical University in Prague. Its orientation is determined partially by the needs of the Josef Božek Research Center, that deals with automotive problems in general. Due to the shape demands and flow properties, such industrial applications often require turbulent models of the flow.

Therefore, suitable turbulence models are being implemented. Two CFD codes are used for their validation, as well as for the cross-validation of codes. The first own in-house code is based on a cell-centered principle FVM (Finite Volume Method), solving 2D and 3D Navier-Stokes equations with laminar or turbulent closure (one equation Spalart-Allmaras turbulence model). The spatial accuracy is improved by the use of a linear reconstruction with a limiter.
The second CFD package, *COOLFluiD*, deals with two equations Menter's turbulence models for cell-centered methods. The original accuracy is improved with the reconstruction based on the least squares approximation with an suitable limiter. In order to improve the solution accuracy and convergence, the cell-vertex scheme RDS (Residual Distribution Scheme) has also been used, for this solver. One equation S-A turbulence model has been implemented. Recently, this model has been extended for higher order discretization, with linear grid elements and parabolic solution interpolation. This discretization has been validated on airfoil testcases, e.g. an multi-element airfoil, at landing configuration (Figure 1), with low freestream Mach number and big angle of incidence.

The future step is the use of these methods for automotive industrial problems and furthermore to implement, test and validate more robust turbulence models with first and second order closure of the Reynolds stress tensor.

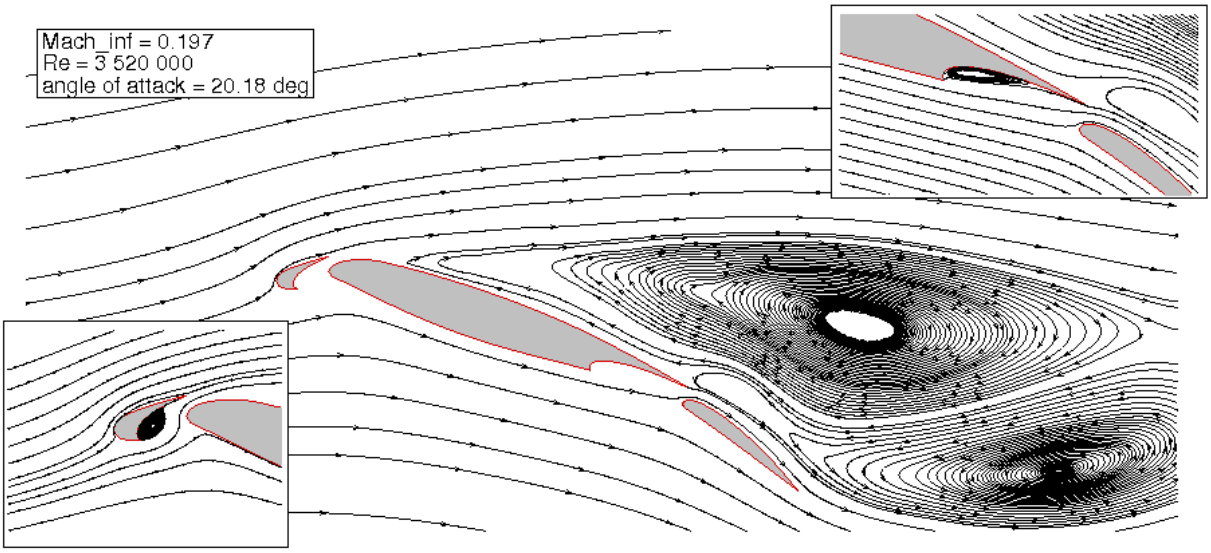

Figure 1: Velocity streamlines around a multi-element airfoil at landing configuration higher order RDS, turbulent computation