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USING OF THE ENTROPY INDEX IN THE INLET BOUNDARY CONDITION

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It is well known, that a convergence of solution of the CFD problems is very strongly influenced by the formulation and realisation of the boundary conditions as shown in [1, 2]. This paper deals with formulation of the inlet boundary condition, for solution of the compressible Reynolds averaged Navier-Stokes equation, using the entropy index $s = p/\rho^\gamma$, where s is the entropy index, p is the static pressure, ρ is the static density and $\gamma = c_p/c_v$ is the ratio of specific heats.

The entropy index is here in the boundary condition used in two cases: a) for starting of the supersonic flows, b) for transfer of information about the dissipative structures between two computational domains.

Using of the entropy index $s = const = p_0/\rho_0^\gamma = p/\rho^\gamma$, where p_0 and ρ_0 are the total pressure and the total density respectively, together with supersonic inlet velocity prevent to setting of the subsonic flow before aerodynamics throat as shown figure 1.

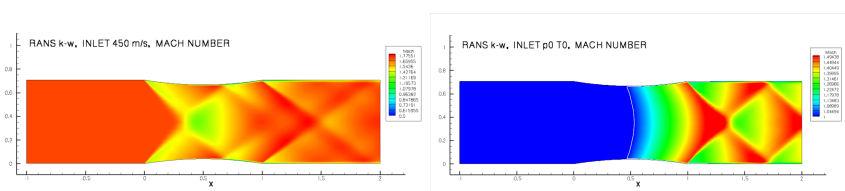

Fig. 1: Supersonic inlet – inlet boundary condition prescribed supersonic velocity and the entropy index s (left); subsonic inlet – inlet boundary condition prescribed the total pressure, the total temperature and the inlet angle (right)

The entropy index includes the information about the dissipative structures due to boundary layer, shock waves and separation (see figure 2). Distribution of the entropy index from flow-field in channel in figure 2. is used as the inlet boundary condition for the part

of the channel in figure 3. We can see, that the flow-field in the part of channel in figure 3. is almost the same as in figure 2., because all information about dissipation due to flow around the circular arc are included in prescribed distribution of the entropy index.

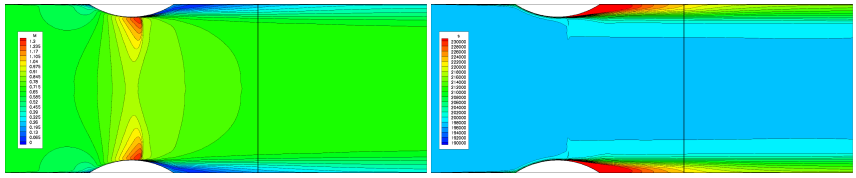

Fig. 2: Transonic flow-field in a channel - Mach number (left); entropy index (right)

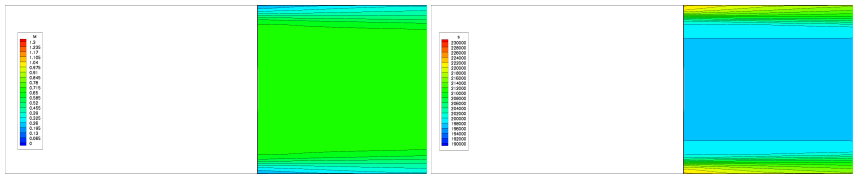

Fig. 3: Inlet boundary condition prescibed distribution of the entropy index - Mach number (left); entropy index (right)

In case of turbulent flow it is necessary to prescribe the turbulent kinetic energy and the dissipation rate of the turbulent energy at the inlet boundary. This can be done so that, for the case, we evaluate the dependency of the turbulent intensity and the ratio of the turbulent and molecular viscosity on the entropy index (see figure 4), and use this dependecy in the inlet boundary condition.

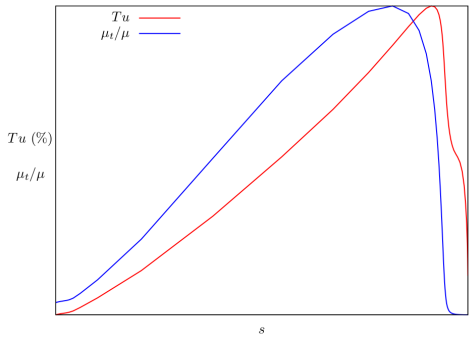

Fig. 4: Dependency of the turbulent intensity and the ratio of the turbulent and molecular viscosity on the entropy index

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