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SIMULATION OF A FREE ROUND JET WITH DISCONTINUOUS GALERKIN METHOD

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In this work, the Discontinuous Galerkin method(Reed and Hill, 1973; Cockburn and Shu, 2001; Li, 2006) has been applied to the simulation of a free round jet. The code – DioGenes – has been developed in the Institute of Thermal Machinery (ITM) for modeling of complex turbulent flows in arbitrary geometries (2D and 3D, unstructured meshes supported). Sample application of the code can be found in (Marek, 2011).

In Fig. 1, the computational mesh is shown (20640 hexahedral elements in total) along with sample velocity field. The accuracy of the simulation has been examined with respect to the order of approximation basis within finite elements (Fig. 2). Linear approximations prove to be insufficient for the particular mesh used. However, the results obtained with parabolic basis are quite satisfactory in terms of the flow statistics on the jet axis (mean axial velocity and its RMS, see Fig. 3). The results have been compared with the data from high-order pseudospectral code – SAILOR – also developed in ITM (Tyliszczak and Bogusławski, 2006).

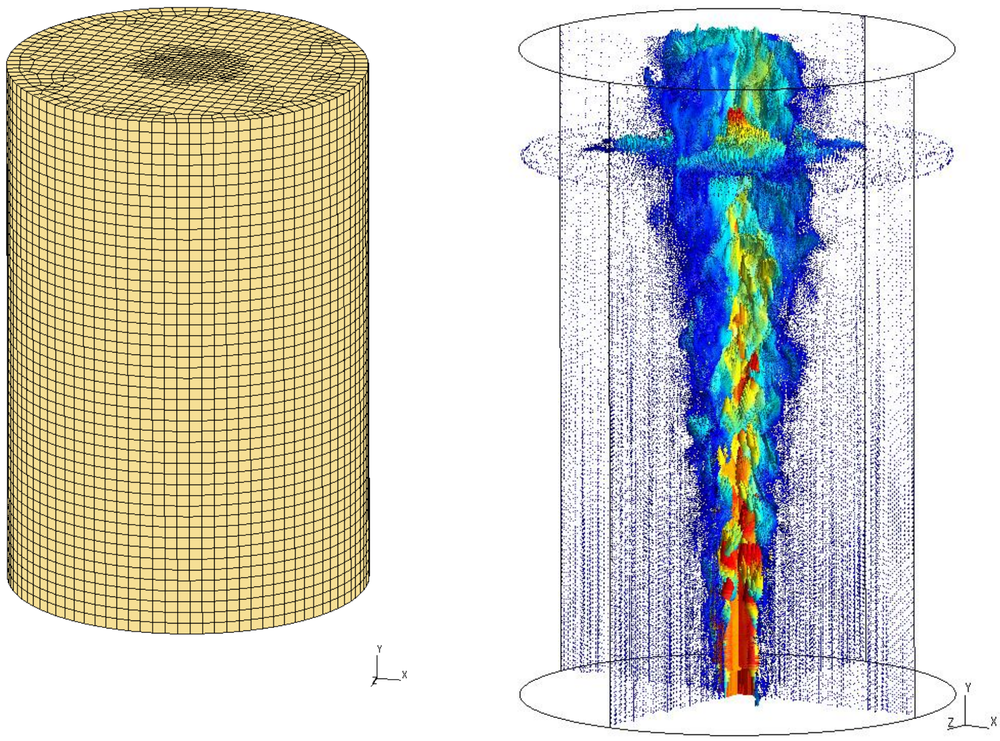

Fig. 1. Computational mesh and sample velocity field.

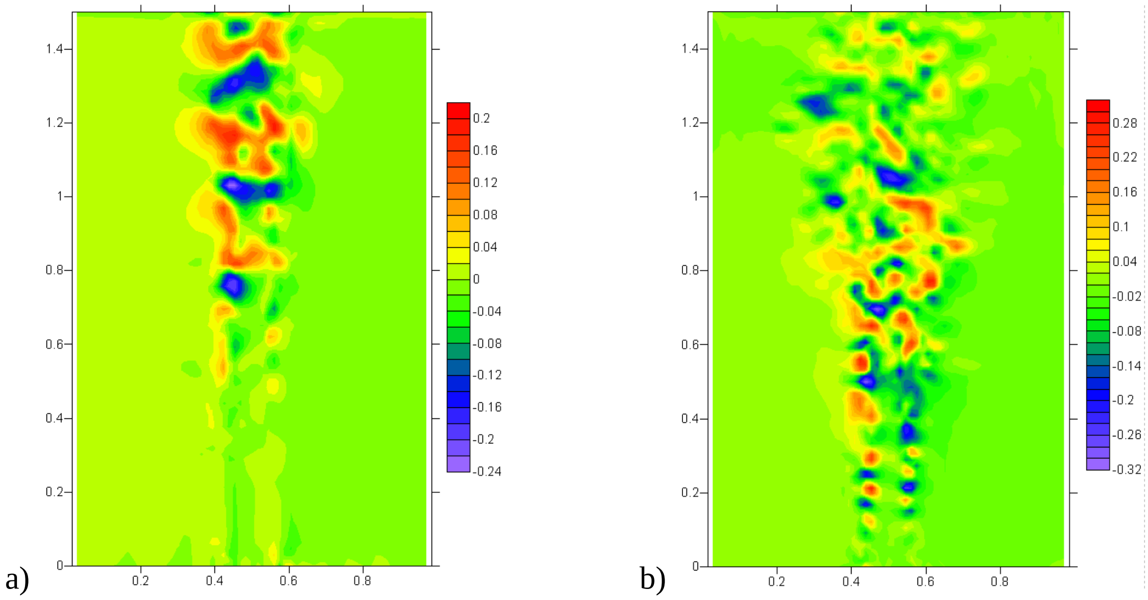

Fig. 2. Radial velocity component for a developed jet: a) P1 (linear approximations), b) P2 (parabolic approximations)

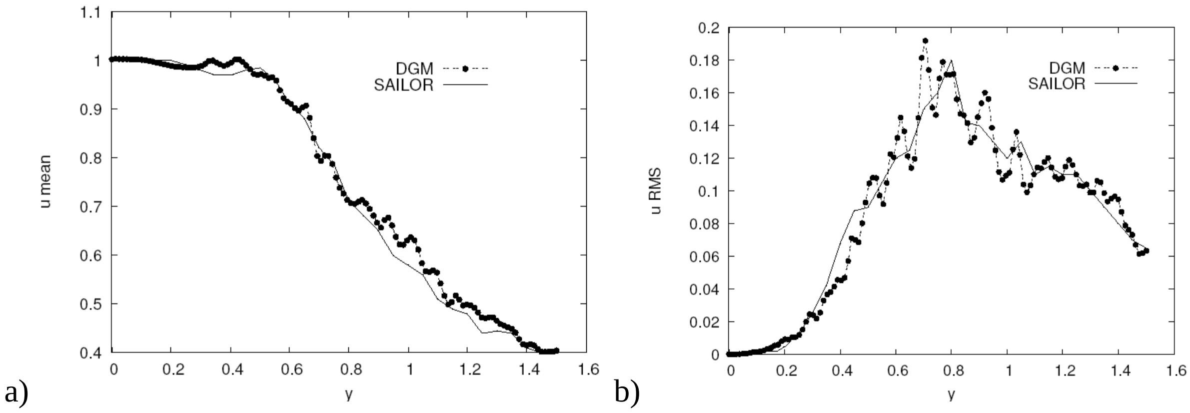

Fig. 3. Mean axial velocity component (a) and its RMS (b) on the jet axis (P2). Comparison of the present results (DGM) with high-order pseudospectral code (SAILOR)

References

Reed, W. H., Hill, T.R.(1973): *Triangular mesh method for the neutron transport equation*, LA-UR-73-479, Los Alamos, NM

Li B.Q., (2006): *Discontinuous Finite Elements in Fluid Dynamics and Heat Transfer*, Springer-Verlag, London

Cockburn B., Shu C-W. (2001): *Runge-Kutta Discontinuous Galerkin Methods for convection-dominated problems*, Journal of Scientific Computing, Vol.16, No.3

Marek M. (2011): *Simulation of the flow between rotating disks with Discontinuous Galerkin method*, Journal of Physics: Conference Series, 318 042037, doi:10.1088/1742-6596/318/4/042037

Tyliszczak A., Bogusławski A. (2006): *LES of the jet in low Mach variable density conditions*, Direct and Large Eddy Simulations VI, ERCOFTAC, Springer, pp. 575-582