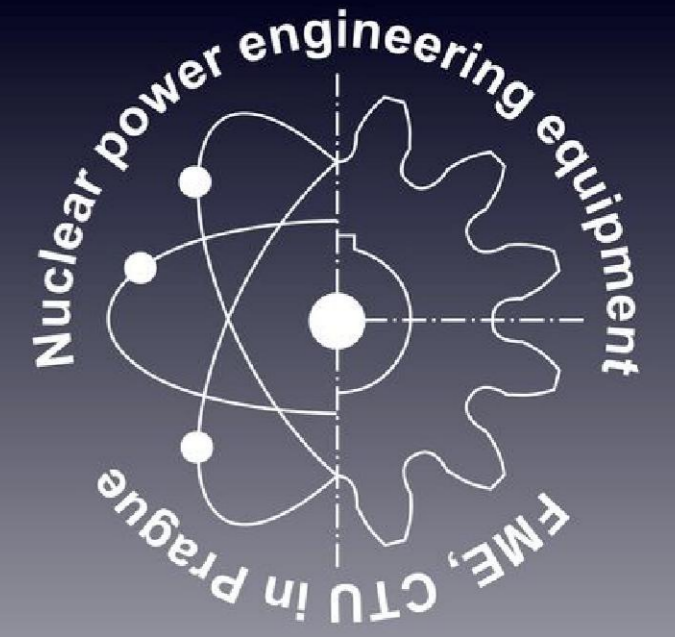




CFD Study of the Spacer Grids and Mixing Vanes Effect on the Flow in the Experimental Fuel Assembly with VVER-1000 Geometry



Authors: Jan Štěpánek¹⁾, Václav Železný¹⁾, Tomáš Zahrádka²⁾

1) Czech Technical University in Prague, Faculty of Mechanical Engineering, Dpt. of Energy Engineering
2) CEZ Group

Abstract

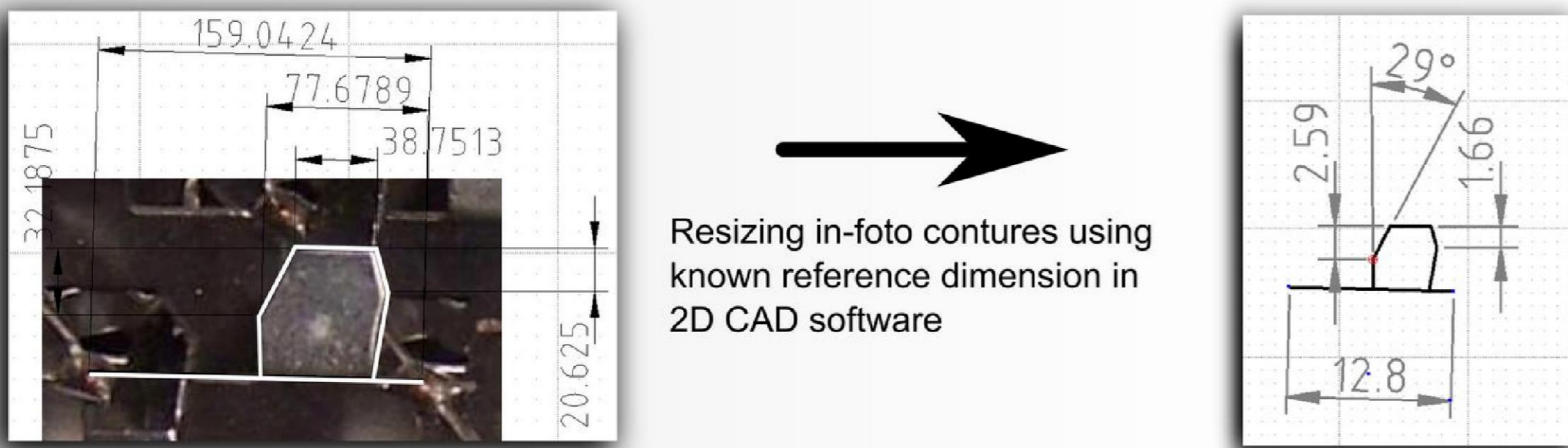
This work deals with creation of detailed geometry and computational mesh within the spacer grid and its surrounding area. The resulting mesh is used for CFD simulation by code ANSYS FLUENT to obtain velocity fields of the flow. In conclusion there are analysis of the spacer grids effect on the flow for calculated configurations of the grid.

Goals

- to create detailed geometry of the grid in preprocessor GAMBIT
- to fill created geometry with so quality computational mesh as possible
- perform hydraulic computation using code ANSYS FLUENT
- analysis of results

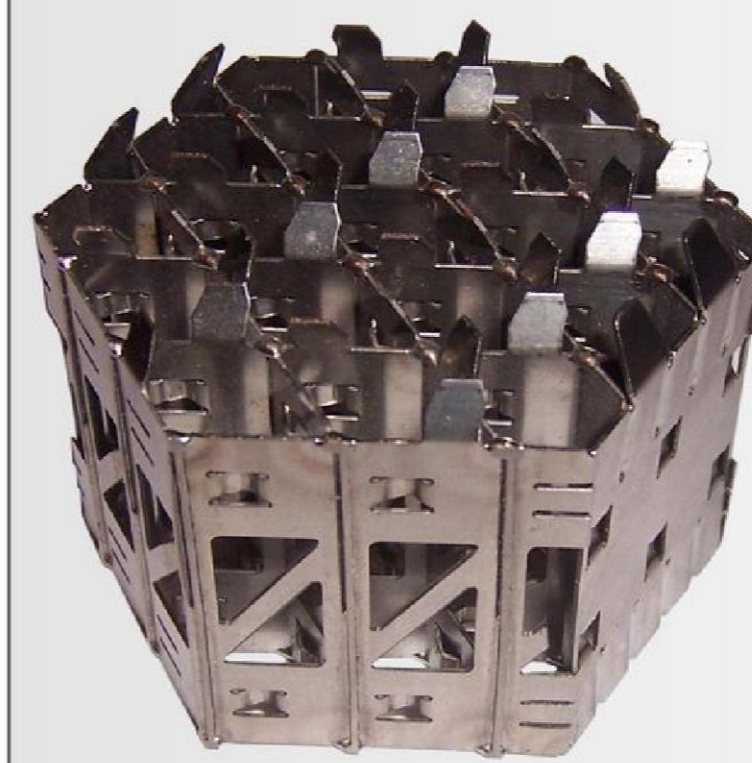
Metrology

Obtaining dimensions by camera, calliper and 2D CAD software

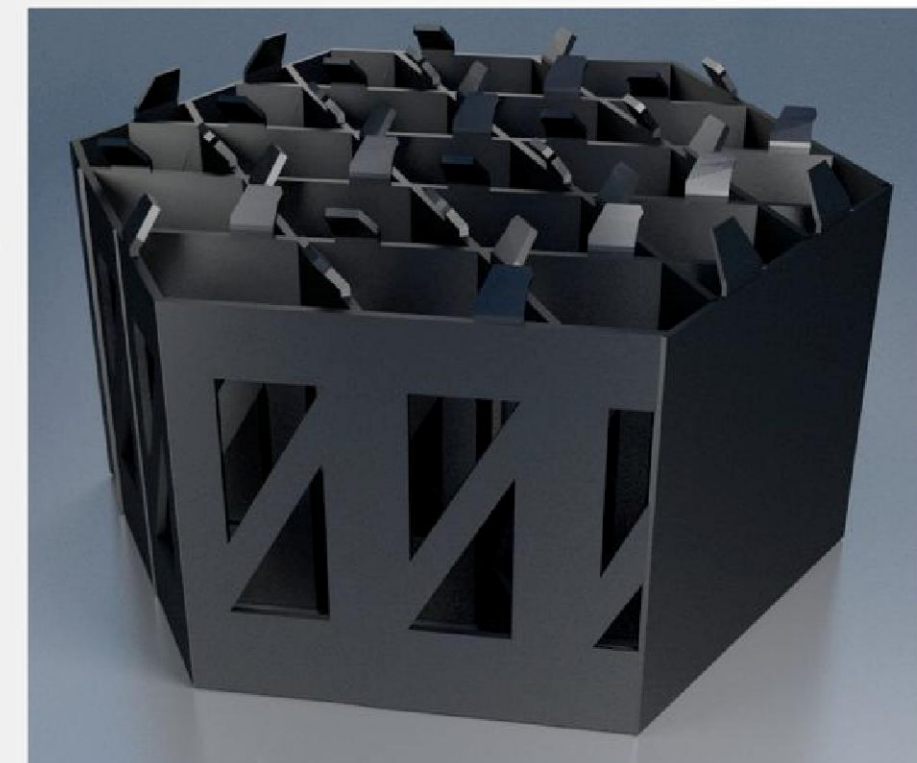


Origin of the solved spacer grid

19-rod spacer grid with VVER-1000 geometry made by WEC, part of model of fuel assembly for thermohydraulic tests, product of Škoda JS a.s.

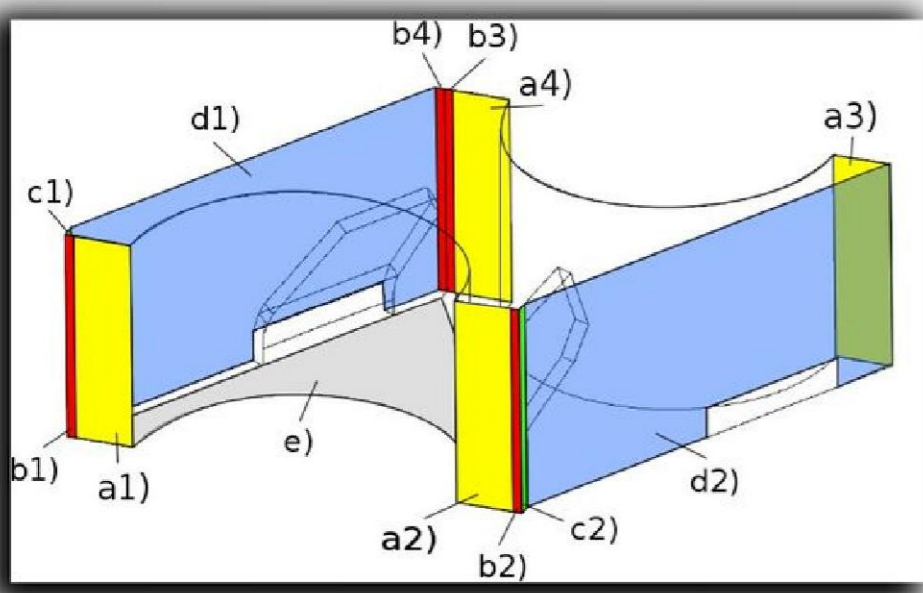


Original spacer grid



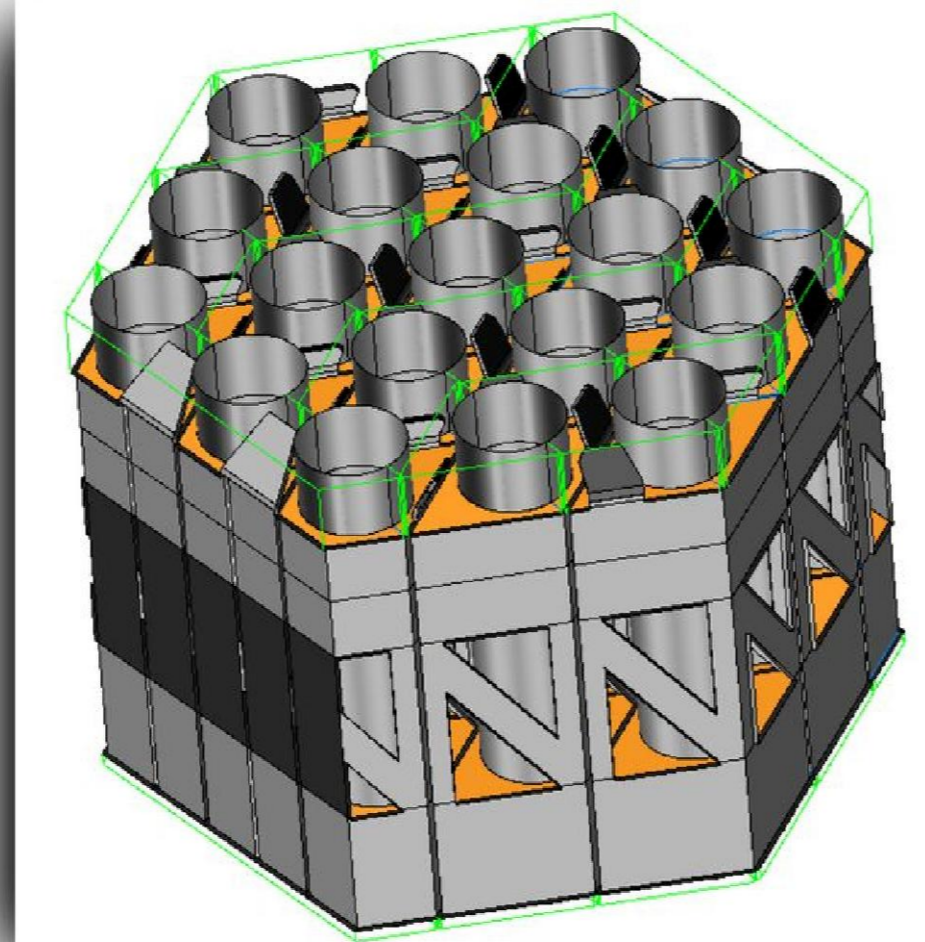
Simplified geometry of the grid (rendered image)

Creating the geometry in GAMBIT preprocessor



Connection of faces

- Mesh parameters:
- almost 17 millions cells
 - equisize skew under 0.8
 - aspect ratio under 0.5



Completed spacer grid in GAMBIT

Computation by code ANSYS FLUENT

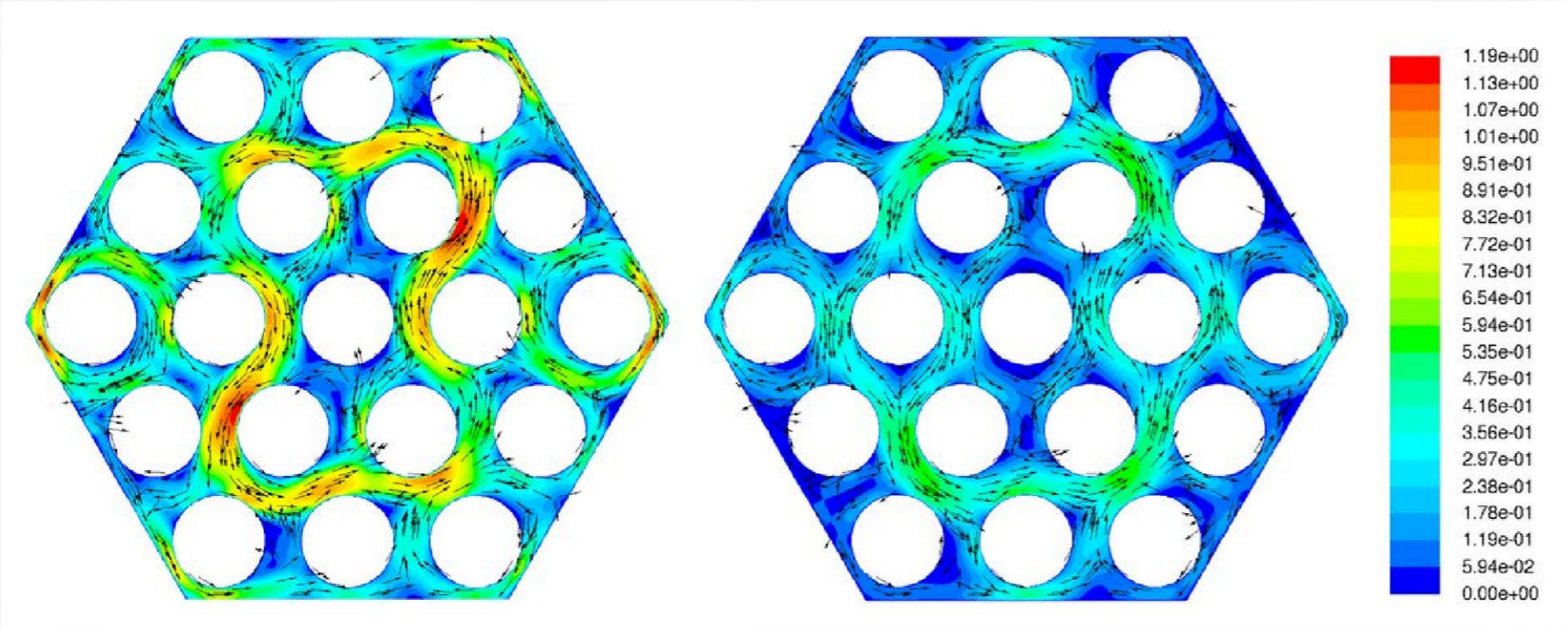
Boundary conditions

- water velocity 5.12 m/s
- inlet pressure 15.7 MPa
- water temperature 290°C
- turbulence model k - ε realizable

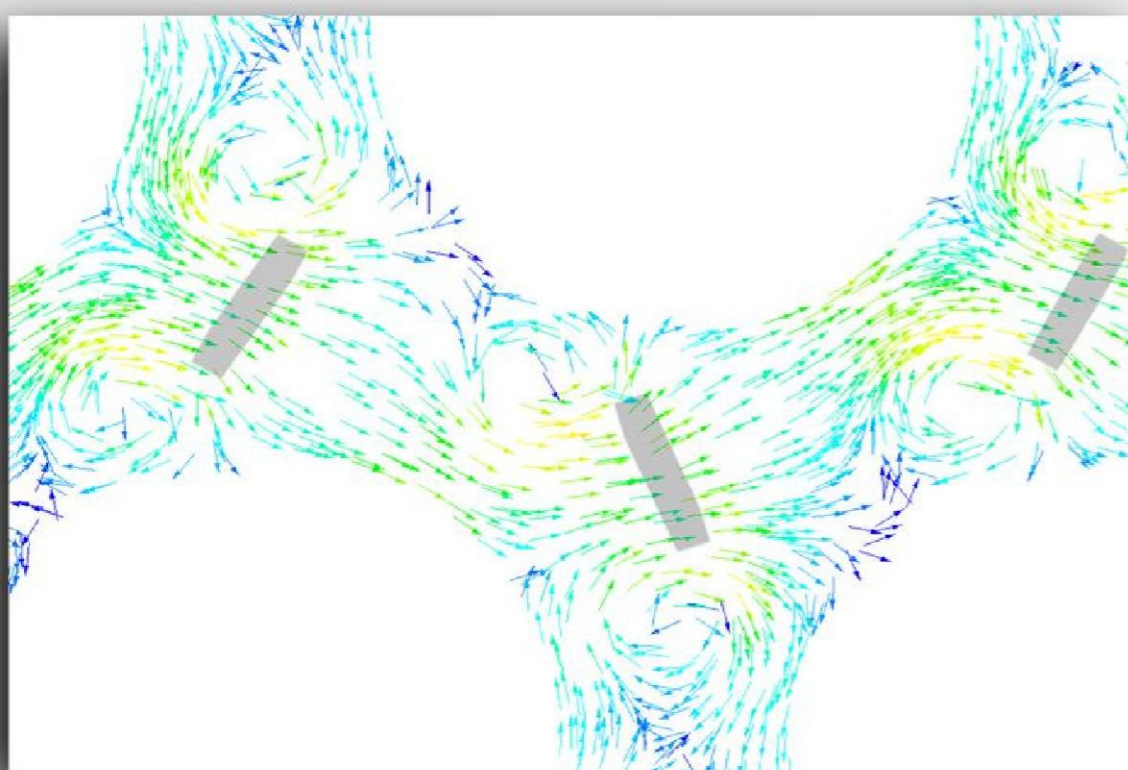
Solved geometrical variants of the grid

- 1) Full detailed geometry with no greater simplification
- 2) Simplified geometry with neglected triangular holes within the grid

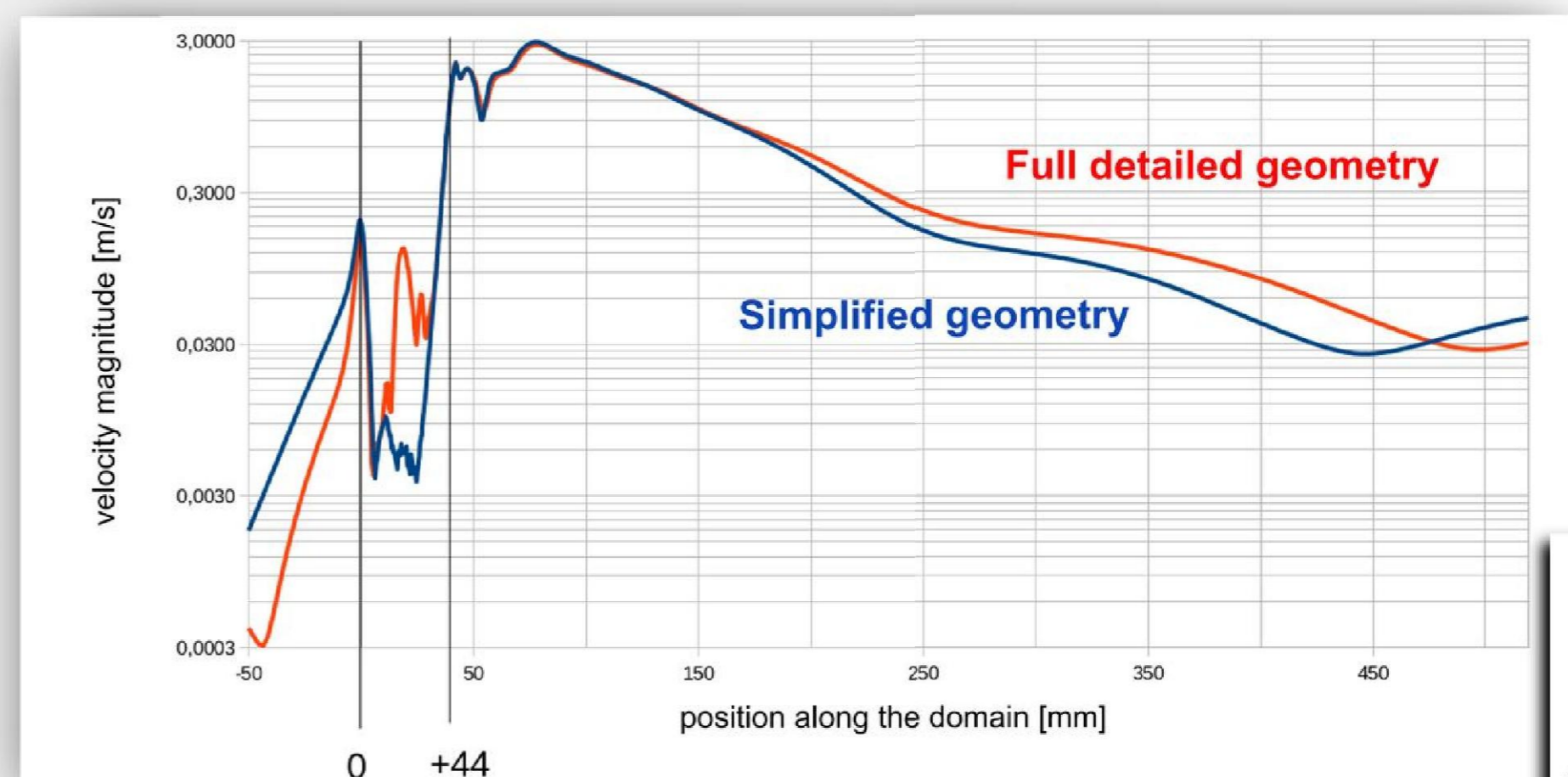
Results



Lateral velocity with vectors 40Dh and 66Dh downstream of the grid [m/s]
1Dh = 8 mm



Lateral velocity vectors on the level containing mixing vanes



Lateral velocity magnitude along the computational domain obtained using line probe positioned as shown on the right bottom picture

Conclusions

- creation of detailed geometry with hi-quality mesh was successful
- proved positive influence of the mixing vanes on flattening of the flow downstream of the spacer grid
- from hydraulic point of view can be triangular holes neglected, there is no noticeable effect on the flow

Contact

j.stepanek@fs.cvut.cz