**Summary of deliverable D3.1: Barotropic LES**

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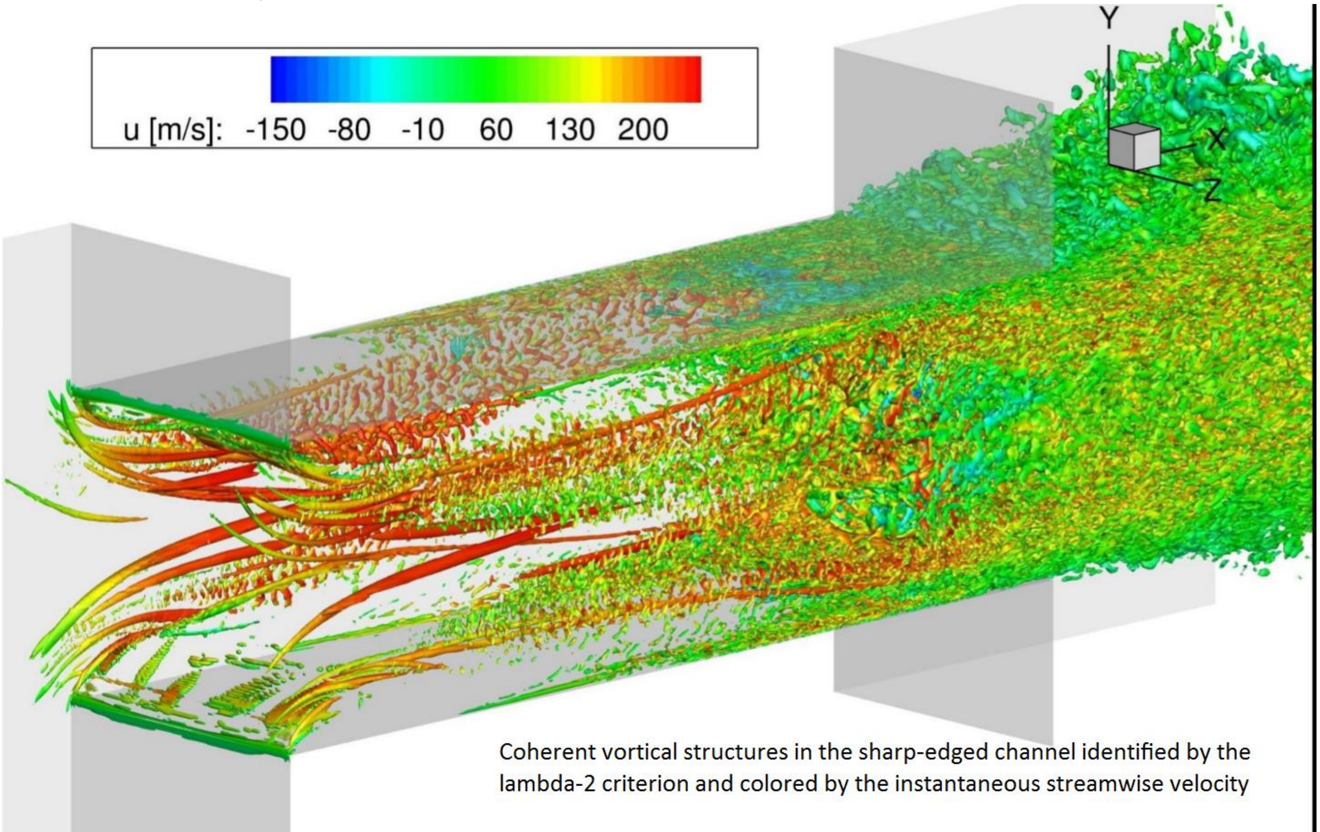


Coherent vortical structures in the sharp-edged channel identified by the lambda-2 criterion and colored by the instantaneous streamwise velocity

The major part of the deliverable (development of an LES approach for cavitating flows using thermodynamic equilibrium assumption) was almost finalized when the ESR started to work on the project and was presented by Egerer *et al*. (2016). Two-phase regions are modeled by a parameter free thermodynamic equilibrium mixture model. A barotropic equation of state is used to describe the thermodynamic states. Compressibility of the working fluid is taken into account for both pure phases and for the mixture region to catch propagation of pressure waves to predict potential material erosion. The truncation error of discretization is designed to act as a physically consistent subgrid-scale model for turbulence. A sensor function, which detects high gradients in pressure, velocity and density, switches the discretization scheme from a third-order upwind-biased to a fourth-order low-dissipative central reconstruction. A 4-cell stencil is used in order to achieve computational efficiency.

The method is applied to simulate the cavitating flow in a sharp-edged micro-channel. The results presented agree very well to reference computations.

A series of developments was additionally introduced:

1) Full thermodynamics: the barotropic LES methodology was extended to handle non-barotropic (full thermodynamic) cavitating flows. Furthermore, a tree-structured adaptive look-up table generator was developed in order to allow for efficient and accurate representation of thermodynamic states.

2) Dynamic mode decomposition (DMD) tools: a pre-existing DMD tool was extended to handle

block-structured data as provided by the LES code. Therefore, data management and data conversion programs had to be developed. The developments were validated by simulating the viscous cavitating flow around a cylinder. DMD analysis of the previously described test-case results were presented on a recent workshop on cavitating flows “Cavitation Colloquium 2016” in Duisburg.

3) Validation and additional test-cases: cavitating flows of cavitating parahydrogen was simulated in order to assess the influence of pressure and temperature. Additionally, computational grids were generated and large eddy simulations using the existing code was performed to simulate the cavitating flow in a microchannel with sharp edges and a barotropic description of the working fluid in order to further compare with the full-thermodynamic case.