Comparison Between COMSOL Multiphysics® and STAR-CCM+® Simulation Results and Experimentally Determined Measured Data for a Venturi Tube

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Numerical simulation tools offer the opportunity to ascertain characteristic values of fluid flow applications, which are difficult to measure. This work describes the examination of a turbulent flow in a Venturi tube using two different commercial CFD tools, namely COMSOL Multiphysics® and STAR-CCM+®. The simulation models are validated by experimentally determined measured data.

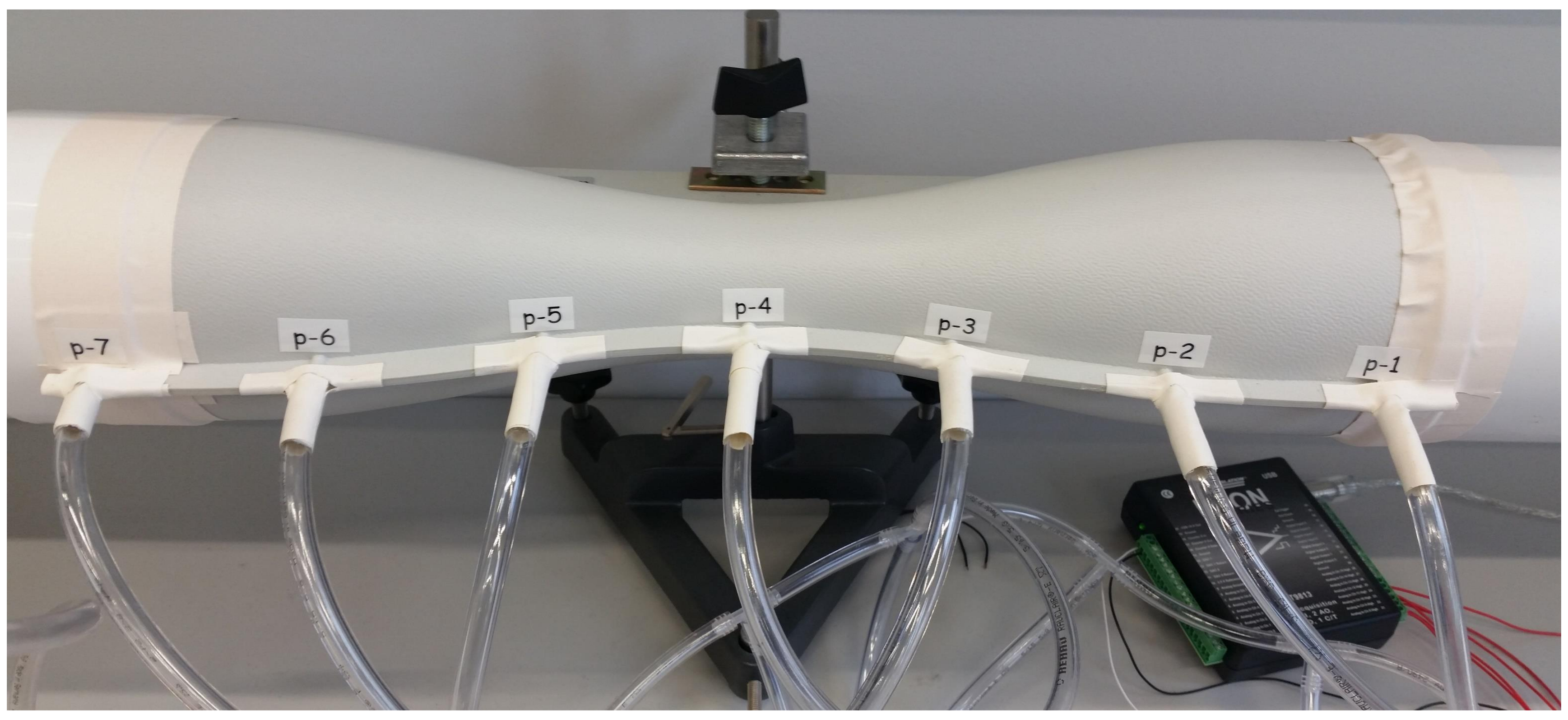

Figure 1. Venturi tube with connected pressure measuring pipes

In the experimental set-up seven pressure sensors are used to measure the pressure difference between the narrowest and the widest cross section of the tube for different flow velocities (cf. Fig. 1).

Numerous simulations using the k-ε as well as the k-ω turbulence model were performed in both CFD tools. Figure 2 shows the velocity distribution in the Venturi tube for a mean velocity of 6 m/s exemplary. The flow enters from the left.

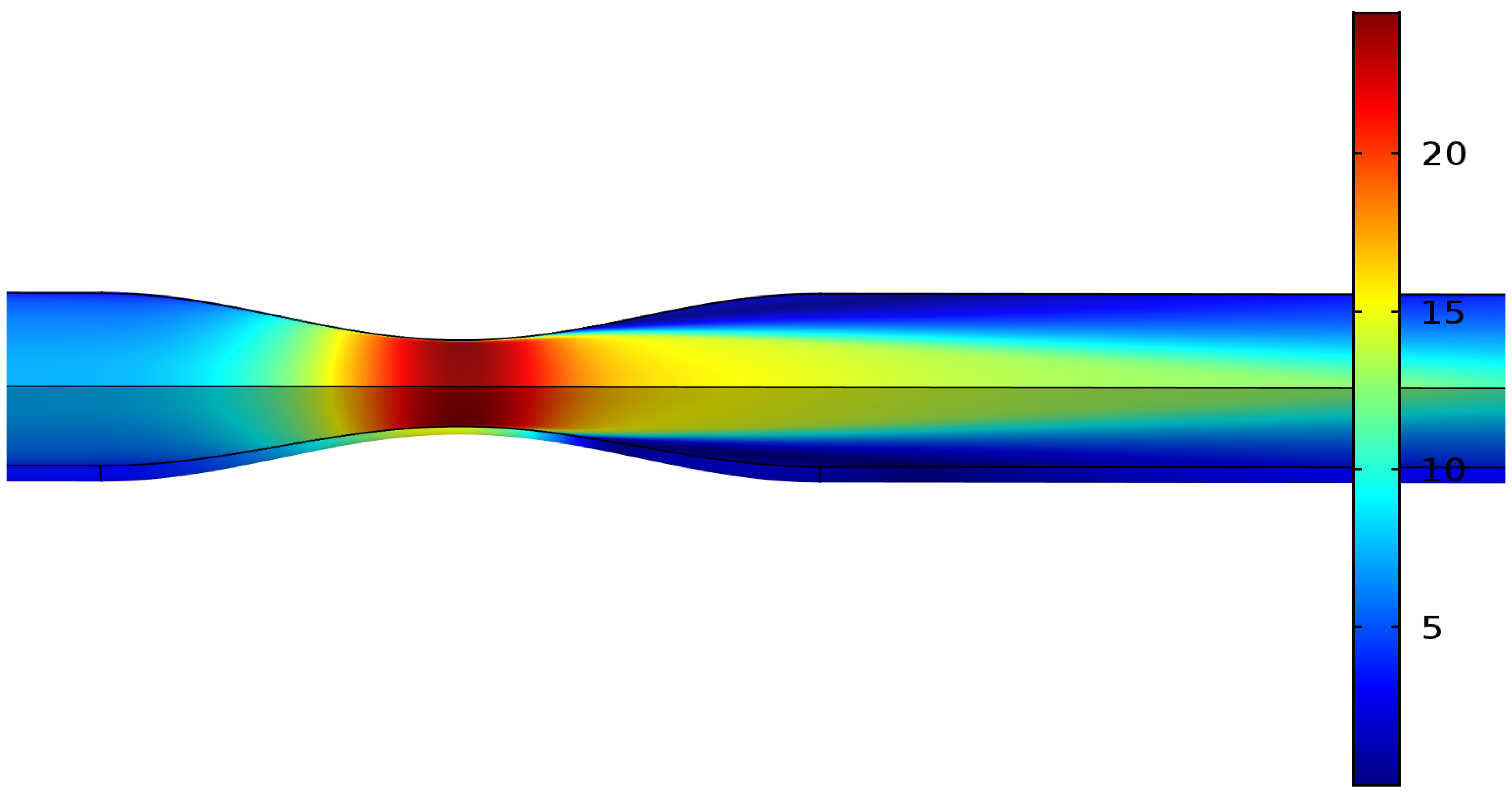

Figure 2. Velocity distribution (Unit: [m/s])

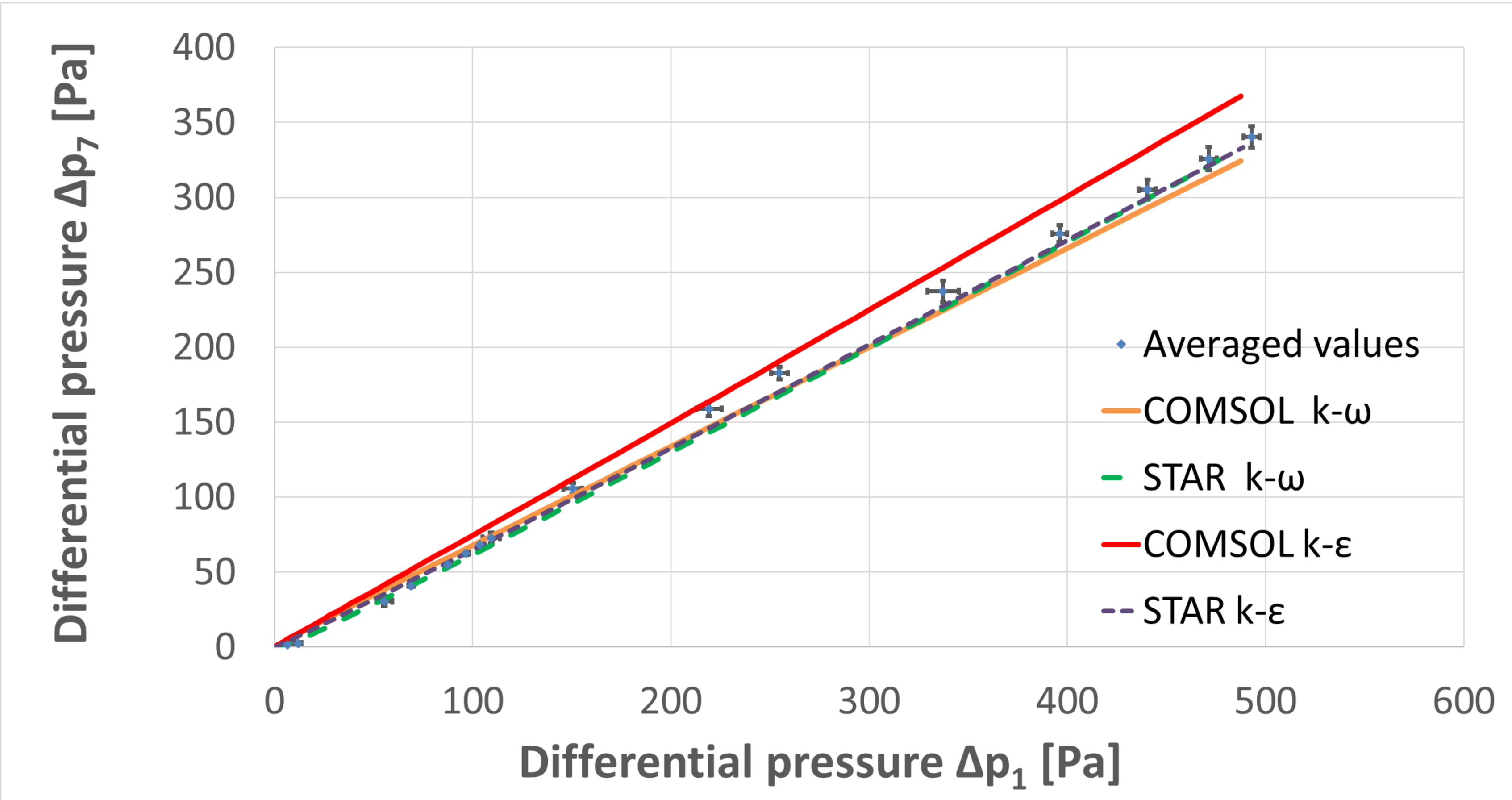

Figure 3: Comparison between the simulation results and the measured values.

The simulation results are in good agreement with the experimentally determined measured data (cf. Fig. 3). In the case under consideration the k-ω turbulence model results are closer to the measured data for a larger range of the differential pressures in comparison to the k-ε model results.

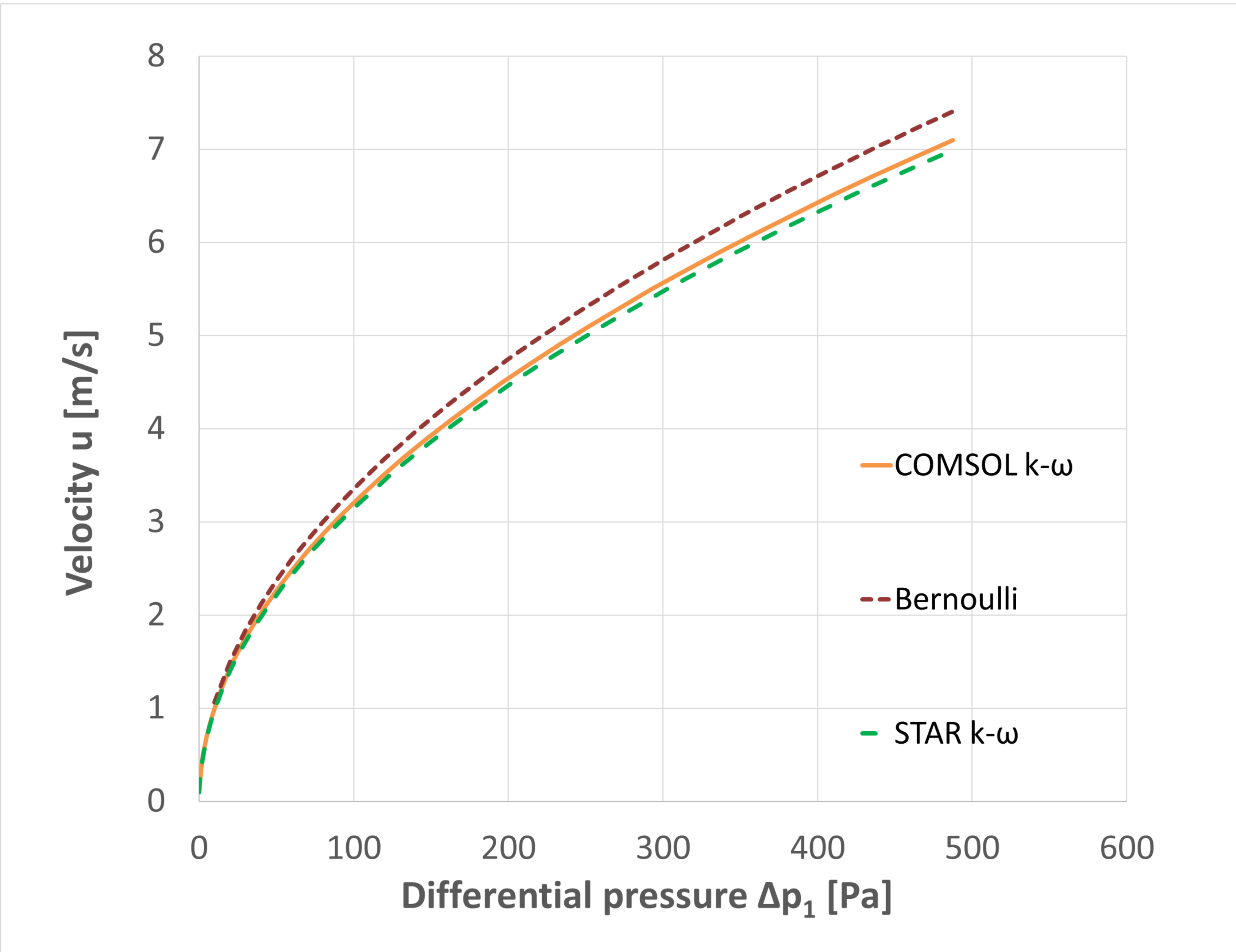

Figure 4: Characteristic curves for the Venturi tube

The characteristic curve for the Venturi tube can be determined by simulation instead of time consuming and expensive measurements. Figure 4 illustrates the characteristic curves which are obtained from the simulation results and by using Bernoulli's equation.