

COUPLED ORGAN PIPES AND SYNCHRONIZATION – NUMERICAL INVESTIGATIONS AND METHODS

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ABSTRACT

We present a new approach to investigate the interaction of two organ pipes numerically. By solving the compressible Navier-Stokes equations under suitable boundary and initial conditions we can completely retrace the way of mutual interplay of the nonlinear coupled system of two organ pipes, which leads to synchronization. We give detailed insights into the concept of implementation and run such complex CFD/CAA simulations using parts of the open source C++ toolbox OpenFOAM. Our robust numerical results are in excellent accordance to data of real synchronization experiments with organ pipes. This opens a new window to analyze the nonlinear fluidmechanical and aeroacoustical mechanisms of sound generation, sound propagation and acoustical interaction of organ pipes. Especially the properties and functions of coherent turbulent fluidmechanical objects inside organ pipes, like the oscillating air sheet, the jet, and the primary vortex in the lower resonator region, as well as the influence of the upper labium are of our augmented interest. The shown techniques define a new step beyond the present research of interactions of wind driven musical instruments.