FSI-analysis on Vibrations of a Rod Exposed to Axial Flow

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Abstract

Flow induced vibrations (FIV) is an important area in many industrial fields, including the nuclear power as the fuel rod and also other slender structures are affected by the cooling water flow. Fluid-structure interaction problems can be solved by coupling a structure solver to a fluid solver and in each time step iterate to a solution. Different solvers can be used, but the coupling codes still need to be tested and evaluated to be used for industrial purposes. Experiments have been performed by Vattenfall R&D to create data for FSI-software validation and to see how an axial flow along a slender structure can cause vibrations of the structure [1]. In order to prove the reliability of the FSI-simulation software the purpose of this project was to see if the rod vibrations, induced by the axial flow, can be predicted with coupled FSI-simulations in ANSYS. An FSI-analysis of the same geometry as in the experiments has been carried out and the simulation data were compared to the experiment data. Different meshes, different turbulence models and structural damping were also investigated on how they affected the solution.

The LES turbulence model could induce vibrations, while the URANS turbulence model could not. The vibration frequencies match the eigenfrequencies for the tube both in the experiment and in the simulation. The amplitudes increase with increased mass flow, but the amplitudes were higher in the simulations compared to the experiment. The differences could be because of discrepancies between the ANSYS model and the experiment, since there were some uncertainties in the documentation of the experiment. The simulations seemed not to be sensitive to time step or damping, but a coarse mesh resulted in lower amplitudes compared to a finer one.

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References

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