Effect of the fluid-structure interaction on the wave propagation in hydro-electric power plants

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The paper summarises the basic features of dynamics of fluid-filled pipes. The axisymmetric motion is addressed in some detail as it represents the key factor governing the propagation of pressure pulsations at lower frequencies. The full coupling between the fluid and the pipe is taken into account, which enables to establish the link between the pressure pulsations and the stresses in the pipe wall. Emphasis is given on advanced processing techniques aimed at the analysis of pipe dynamics using signals from a localised multi-sensor array.

First, the signals from such an array are processed via a particular cost function for identifying the true speed of pressure pulsations which depends on the state of fluid and on the elasticity of pipe wall.

The technique of separation of the forward and backward components of pressure pulsations is outlined. It is further shown how the pulsations and the stresses can be reconstructed along the pipeline.

Advantages of the use of an external, non-intrusive sensor for the detection of pressure pulsations are outlined.

Finally, several measurements carried out in laboratory and in real hydropower plants are presented to demonstrate the different techniques of multi-sensor analysis in a fluid-filled pipe.