Analysis of fast transients in flexible piping

CONTEXT

Pi is the first tool in Salome Meca 2019 specialized in the analysis of transients occurring in piping such as water hammer, rupture, and whip. It includes a set of pre and post-processing tools organized in a unique interface, seamlessly driving a Europlexus explicit finite-element / finite-volume solver.

Pi was designed with a consumer-focused approach, and its active development started in 2017. The challenge was to significantly reduce the time required for carrying-out complex fluid-structure interaction studies involving fast transients. Pi v1 (Salome Meca 2019) typically allows an engineer to deliver a complete water hammer study from scratch in less than a day, compared to nearly a week using previously available tools.

PRE-PROCESSING

The pre-processing module of Pi allows users to build their own model from scratch by interactively adding construction points, piping sections (straight or curved), hydraulic elements (such as pumps and valves), and also by defining and attributing materials (solid and fluid), cross sections, and setting initial and boundary conditions. This information is progressively displayed on the model view and thus can be visually verified by the user. A complementary 3D view of the pipeline is provided in order to verify the geometry and the cross-sections.

In addition to facilitating user input, Pi automatically checks the validity and coherence of the input, warning the user in real-time in the case of validation failure and suggesting common workarounds or solutions.

CALCULATIONS

SUBMISSION – FOLLOWUP – MANAGEMENT

Once the input model passes validity check, a calculation case can be created by the user by completing a simple wizard (numerical parameters such as modeling considerations, simulation time, etc.). The following steps are then successively carried out:

- Automatic generation of the calculation mesh (based on meshing constraints provided by the user) and of the Europlexus (epx) input file (based on the complete user input for the piping model and calculation parameters provided in the wizard);

- Effectively launching and following up on the calculation progress, which can be executed locally or on a distant server.

POST-PROCESSING

For “completed” or “in progress” calculations, Pi provides integrated interactive tools to post-process the complete or preliminary results:

- Plotting and superposition of time evolutions of different quantities at the points of interest (such as pressures, temperatures, forces, etc.)

- 3D view/animation of the fields calculated by Europlexus and relevant to the study such as pressures and displacements.