STEADY STATE SIMULATION OF A PRESSURE RELIEF VALVE USING CONVERGE

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ABSTRACT

Pressure relief valves are used in several industrial applications as a safety feature. The function of a relief valve is to release excess pressure from a system and to maintain it in a safe operating state. Hence, it is crucial to know when these devices would fail. A common way of obtaining this information is through techniques such as Computational Fluid Dynamics (CFD). However, one of the major bottlenecks in this type of analysis is the meshing. In a pressure relief valve, the geometry can be quite complex with a lot of small gaps and moving parts. For example, the valve spindle moves due to the pressure forces acting on it. This makes the process of meshing hard as the mesh needs to be compatible at each and every position that the spindle might take. Another challenge arises while trying to refine flow regions that are continuously evolving. This is typically tackled by using a fixed refinement. This approach is less effective and can be slow for the following reasons. Firstly, it is hard to predict where the fixed refinement needs to be used. Hence, a few simulations might need to be performed. Secondly, as performing grid dependency study is hard in cases with complex geometry a single mesh with a fine resolution is commonly used. This can lead to longer runtimes.

As the main objectives behind this work are to accurately predict the pressure forces on the plunger of a pressure relief valve as the lift changes and to resolve the computational mesh adaptively, CONVERGE CFD is used. It was observed that the use of AMR (Adaptive Mesh Refinement) helps cut-down the simulation time drastically while maintaining accuracy.