APPLICATION OF DIFFERENT MODELS FOR MODELING ABRASIVE WEAR

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Different mechanisms cause the decrease of efficiency of hydraulic machinery. One of these is abrasive wear due to solid particles in the working fluid [1]. Those abrasive particles are transported in the flow through the machine. The contact between the particles and the hydraulic machine can lead to a mechanical damage of the surface. There are different possibilities for modeling abrasive wear, here, a grid-less approach in combination with an erosion model is applied and different models for simulating the abrasive wear are compared.

The impact of a free jet with loading on a hydraulic machine is simulated in this work. Therefore, different simulation methods are coupled for modeling this complicated problem. The fluid is modeled with the Smoothed Particle Hydrodynamics (SPH) method. An overview about the SPH method can be found in [2]. The loading of the transport fluid is modeled with the Discrete Element Method (DEM). The hydraulic machine is also discretized with the DEM, therefore triangle shaped DEM particles are used.

In classical fluid dynamical simulation, grid-based methods are applied for the simulation. In this approach we are using only grid-less methods. There are several advantages of these methods in comparison with grid-based methods. In this way, the influence of the contact force between particles to their trajectories can be simulated. Also the description of the free surface of the jet requires less computational effort with a grid-less method than with a grid-based method. Another point is the description of the interface between the SPH material and the DEM material. The calculation of the fluid-structure interaction is much easier with grid-less methods.

For the modeling of the wear an erosion model [4] is applied. There are several models available in literature. The accuracy and computational effort of these models are different. They take various parameters into account for modeling the wear, e.g. velocity,

impact angle and material properties. In this work different models are implemented and investigated. The models are used to simulate the removed material from the surface due to the contact between the solid particles and the boundary. In Figure 1 the wear due to the impact of a free jet with loading is shown. The advantage of these models is among other things that the simulation of wear does not need much computational time in comparison with approaches based on the Finite Element method.
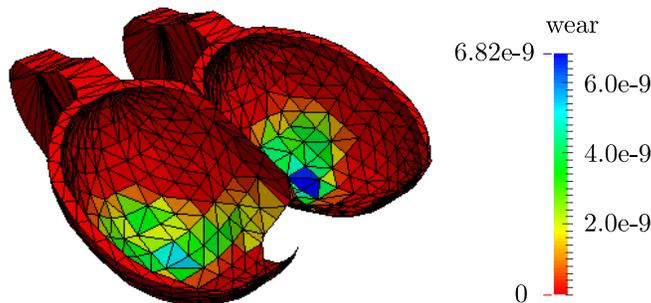

Figure 1: Abrasive wear of a pelton bucket due to an free jet with loading.

The results of the simulations with the different wear models are analyzed and discussed. For the simulation the software package Pasimodo [3] is applied, all methods are implemented in this package.

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