Master Project Proposal

Dynamic modeling of a Multiphase Pump

Multiphase Pumps (MPPs) are used to pump media streams consisting of different phases. In the oil and gas industry these media are primarily oil, water and gas. Oil and water are thereby considered to be incompressible, whereas the gas phase is compressible. This can raise several issues, especially when the gas volume fraction is high compared to the liquid volume fraction. The consequences can be overheating of the pump or a decrease in performance, for example. MPPs can be used to tie-in remote fields to existing subsea processing infrastructure, hence making separation and single-phase pumping obsolete at the tied-in field. Furthermore, they can be used to increase recovery and extend the lifetime of a field as well as enable production from low energy fields (so called booster pumps).

Several principles exist, where the Helico-Axial and the Twin-Screw Pump are the most widely used in the oil and gas industry. In this study we want to concentrate on the Helico-Axial type, which relies on principles of centrifugal pump / compressor technology. Hence, a good starting point would be to review existing models (dynamic / steady state) for centrifugal pumps and compressors.

The model should be able to describe the flow and the pressure of the multiphase stream as well as the wheel speed as dynamic variables. In addition the model should be able to model for surge and/or rotating stall as it can be observed in compressors. One could additionally think about including pressure accumulators and the pipe into the model.