

Cavitation CFD Modeling and Optimization of LI WU Power Plant Water Turbine

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I. Background

The phenomenon of cavitation was observed during the operation of one of the LI WU power plant's water turbines. The cavitation led to alternating stress on the metal surface and caused fatigue and considerable damage to the impeller blades. Via reverse engineering on the impeller, we built a parametric CAD model. A CFD model was later built to analyze and simulate the fluid dynamics, pressure field and the cavitation phenomena. The parametric CAD and CFD model were subsequently integrated by SmartDO design optimization platform to perform numerical design optimization. In this research, SmartDO was used to design an optimization and integration platform, NX as the CAD and StarCCM+ for CFD.

II. Contents of the Research

The major tasks of this research are as follows:

1. algorithm- building CAD and CFD optimization mathematical models.
2. Build up parametric CAD model of the water turbine using NX.
3. exporting CAD model from NX into StarCCM+ for CFD modeling.
4. Integrate the results of 1~3 with SmartDO for

automatic design optimization

Figure 1 the process flow of the project.

III. Results of the Research

The results of this research are as follows:

1. An automated parametric CAD model for water turbine impeller in NX software, as shown in Figure 2
2. Successfully established the process of predicting cavitation behavior during the operation of water turbine by StarCCM.
3. Integrated 1 and 2 with SmartDO to build a fully automatic design optimization system for water turbines, with consideration of the fluid dynamics performance and limitation of cavitation simultaneously.
4. In our example, SmartDO successfully generated a new optimized design with about a 60% higher output torque than the original design. Figures 3 and 4 are the comparisons made between the original design and the optimized design by SmartDO.

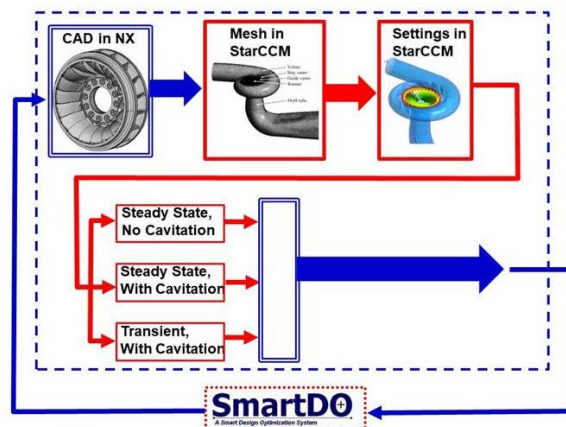


Figure1 Process Flow of the Project

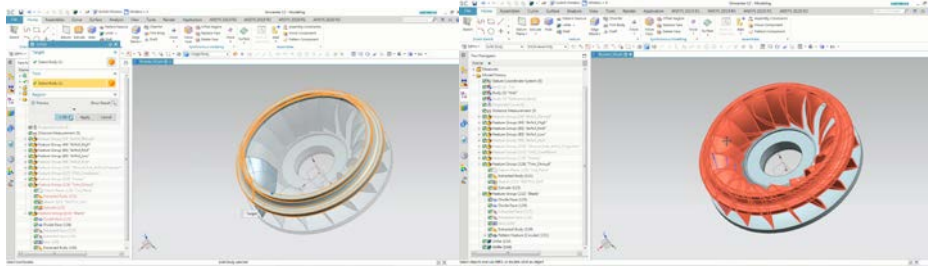


Figure 2 Building up an Automatic Parametric CAD Model for the Water Turbine in NX

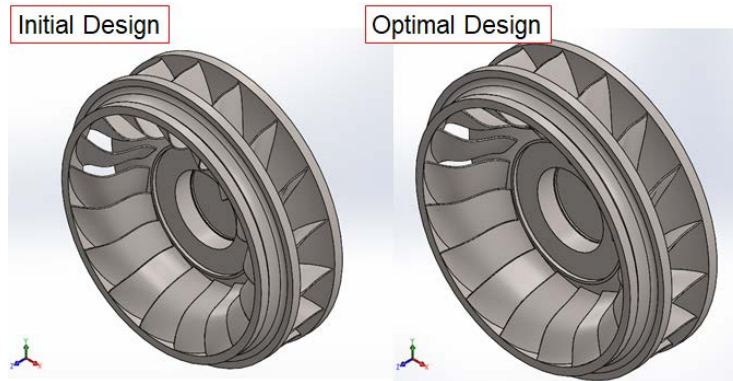


Figure 3 Initial Design (left) and Optimal Design by SmartDO (right)

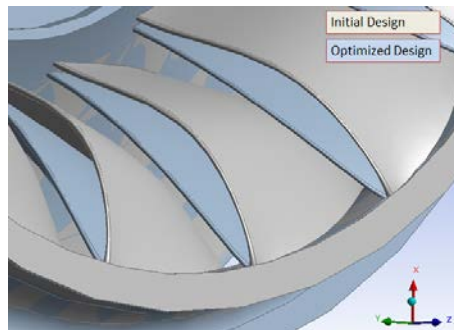


Figure 4 Initial Design and the Optimized Design by SmartDO