**Abstract**

This thesis establishes a Multi-Fidelity concept that enables the prediction of performance parameters of state of the art 8 stage axial High Pressure Compressor for wide operational range utilizing Streamline Curvature Method as Low Fidelity cost effective sample, and High Fidelity 3D CFD computations for expensive sample. For the preparation of the concept validation run, several sensitivities studies have been performed.

In the beginning of CFD computation studies, simple representation of the compressor geometry was developed, containing only main gas path. For this configuration, studies on mesh resolution and turbulence model were performed to find best setup suitable for considered all three rotational speeds – High, Mid and Low Speed conditions. After establishing the setup which delivers satisfactory quality, studies on model detail complexity were conducted. As an outcome, sensitivities on different geometrical features being a representation of secondary-flow volumes, were defined. As the last sensitivity study, Streamline Curvature Method model was compared to the results of CFD solutions. Outcome of this studies had an impact on definition of Design of Experiment for further Multi-Fidelity concept validation.

With enhanced knowledge about sensitivities of 3D and 2D methods, Design of Experiment has been defined. To solve the optimization problem with Multi-Fidelity approach, concept containing Co-Kriging data aggregation has been proposed. With two step surrogate model improvement, it was possible to achieve positive correlation between two data sets for all discussed conditions. As the concept validation outcome, performance parameters, Isentropic Efficiency and Surge Margin have been improved for all three rotational speeds, showing a potential for wide operating range. Finally, conclusions and recommendations for further development have been defined.