OPTIMIZATION OF RADIAL TURBINE BY MEANS OF DESIGN OF EXPERIMENT

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The main aim of the project is achieve more efficient radial impeller and the required mass flow while reducing the cost and the duration of the design cycle by means of well-defined database. The project was divided into two key parts.

In the first part, study of new design technique based on statistic approach, the so-called Design of Experiment, took place. To check the validity of the used techniques, a test function was defined and tested. The DOE techniques allowed indicating which of design parameters were important and could have affected the design or which of these variables were not significant and could be neglected.
Secondly, DOE techniques i.e. The 2^k Design, The 2^{k-1} Design and The 2^{k-4} Design were employed to build databases containing different number of samples. Impact on the accuracy of the Artificial Neural Network was investigated to find out if the use of DOE techniques to construct database is more accurate than the random technique.

The second part of the project was devoted to application of DOE to optimization. Design of Experiment was applied in order to create a representative and more relevant database. In contrast to previous random method used to create the initial database, this time the choice of the geometry samples was performed by means of statistic analysis.
To be able to make optimization the geometry of the radial impeller had to be defined. The meridional contour and the local angle β of the blade were described by the third order Bezier polynomials.
Two parameters in the meridional plane, four of the Beta distribution plus the number of blades have been chosen as the optimization variables.
An automatic procedure has been implemented in order to run the geometry generator, the 3D NS solver, GA and ANN to obtain the performance of the analyzed impeller.

It can be concluded that higher efficiency of the blade and a mass flow closer to the required one have been found in respect to the initial geometry. It is worth highlighting that it is the first time this new design technique was applied to define the database in a more systematic way.

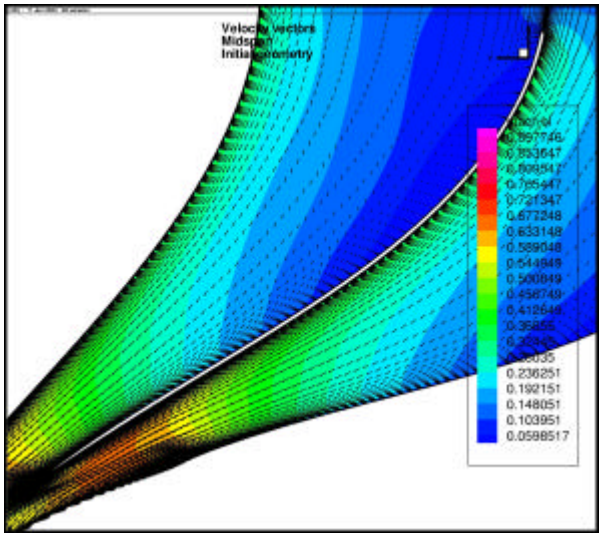

Figure 1: The initial geometry

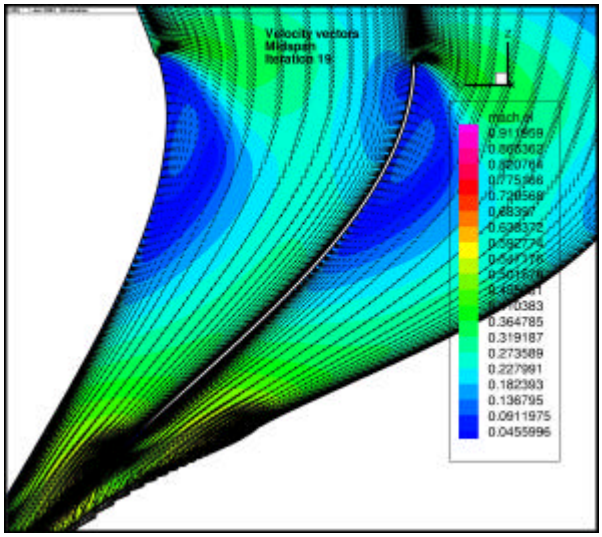

Figure 2: The optimized geometry