INDUSTRIAL APPLICATIONS OF TURBOMACHINERY BLADE DESIGN OPTIMIZATION

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ABSTRACT

Designing a new turbomachine is a complex task, which is highly time consuming and requires large human resources since the geometry should respect many constraints. The first step consists in the definition of the objectives, generally to increase performance of an existing turbomachine, while respecting various constraints. Then this geometry is evaluated according to several criteria: CFD and structural performances, cost of production…

With the raise of computer power and new technologies in optimization, these methodologies are introduced in the design loop at an advanced stage. Several techniques of optimization are available, from zero order to second order. Gradient based algorithms, for example, can converge to a local optimum and not to the global optimum, whereas genetic algorithms are able to reach this global optimum. Moreover, these algorithms require many performance evaluations either to compute the performance of geometry, for zero order methods, or to compute the derivative value of the objective function. Since a computation may need several hours to converge, an approximate model should be considered instead of the real model. This surrogate model is used to speed up the optimization process.

This lecture will cover a short review of available methods and focus on the approach developed by combining a genetic algorithm coupled to an artificial intelligence database system for generation of a surrogate model. The integration with a dedicated geometry modeler for turbomachinery blades and a CFD system, including the automatic grid generation is discussed and illustrated by practical industrial applications.