COLLOQUIUM AANKONDIGING

Faculteit Construerende Technische Wetenschappen

Afdeling **Engineering Fluid Dynamics**
Master opleiding **Mechanical Engineering**

In het kader van zijn/haar doctoraalopdracht zal

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een voordracht houden getiteld:

AN INVERSE DESIGN METHOD FOR PUMP IMPELLER BLADES: A FOURIER SERIES BASED APPROACH

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SAMENVATTING

The design of blades for pump impellers is a complicated task, governed by complex three-dimensional flow phenomena. The indirect relationship between blade geometry and pump performance leads to many iterative design steps, necessary for designing a pump with the desired performance. Inverse design methods can overcome this problem by specifying the performance as input and yielding the flow field, as well as the blade geometry, as output.

In most inverse design methods for turbomachinery blades, a flow computation and a blade shape update are alternated in an iterative procedure. This is done until the blade geometry has converged, satisfying the required pump performance. As the blade geometry and thus the computational domain for the flow computation change during this iterative process, the method has to deal with a changing 3D mesh, which can have odd or even invalid geometries at intermediate steps. The method that is proposed here aims to circumvent this problem.

In this method, an incompressible potential flow formulation is adopted. The velocity potential in circumferential direction from blade to blade is approximated by an assumed profile, involving a Fourier series with unknown coefficients. This transforms the governing equation from the 3D Laplace equation for the potential into a series of 2D Helmholtz-type equations for the Fourier coefficients, defined on the (fixed) meridional plane. The velocity potential can then be reproduced from the computed Fourier coefficients, from which the velocity field in the impeller can be computed.

Validation of the current flow computation method is done by comparison of the current solutions with the solutions from a fully 3D inverse design method. The computed velocities show very good agreement. However, a large number of included Fourier modes is necessary to achieve a reasonable accuracy, because of slow convergence of the Fourier series. This is caused by the occurrence of the Gibbs phenomenon.

It has been proven that the current flow computation method can overcome the problem of the varying mesh and still yield accurate velocities.

EXAMENCOMMISSIE

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