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論 文 要 旨
Abstract of Dissertation

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専　　攻 Department	Department of Mechanical Engineering, Materials Science, and Ocean Engineering
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論文題目 Title	Numerical analysis on the effect of J-groove on flows around rotating disk and casing
和訳または英訳 Translation (J->E, or E->J)	回転円板とケーシングの間の流れに対する J-groove 効果の数値解析

During operation and working of turbo machines such as centrifugal pumps and Francis turbines, axial thrust balancing is important. It is the summation of unbalanced impeller forces acting in the axial direction. Pressure fluctuations occur at the interface between the rotor and stator. This rotor-stator interaction may be responsible for fatigue damage and cracks. To control and balance the axial thrust, a very simple method using shallow radial grooves mounted on the casing wall, called “J-groove”, was proposed, and studied experimentally. The main design criteria for the J-Groove are number, depth, length, and width. This thesis presents a numerical study of the effect of J-groove on the flow in the various gap along enclosed rotating disks based on open-source CFD software. Computational fluid dynamics (CFD) over the past decades has allowed large and complex simulations to be performed in reasonable time, thereby reducing the pre-project budgets largely. Furthermore, it has proven to be a powerful research tool when examining the complex problems and interplay of many phenomena, particularly in turbo machines. This study has improved the current understanding of the remarkable effect of J-groove. It is seen that the difference in pressure between the hub and shroud tip is changed with the changing number, depth, width, and length of J-groove.

Calculations were performed using the Navier-Stokes Equation solver available in OpenFOAM, an open-source Fluid Dynamics software. Furthermore, the code used in this thesis is open source which is obviously an advantage over commercial code. The modeled using Reynolds Averaged Navier Stokes (RANS) models was mostly k- ω SST as it predicted the outcome in the case without J-groove giving results close to the empirical value.

This dissertation consists of seven chapters, and the outline of each chapter is given below.

Chapter 1 clarified the position of this research by stating the background and purpose of this research and clarifying the research subjects.

Chapter 2 briefly presents the basic equations as well as the implementation in OPENFOAM for this thesis.

Chapter 3 presented the validation of turbulence models and the mesh independence, compared with the experimental results in the case of No groove.

Chapter 4 contains the fundamental characteristics of flow in different gaps between

rotating disk and casing without through-flow. Theoretical analysis of effect of J-groove its parameters.

Chapter 5 presents the characteristics of flow in different gaps between rotating disk and casing with inward through-flow. Theoretical analysis of effect of J-groove its parameters.

Chapter 6 describes the estimation of effect of J-groove with various parameters. Determination of optimum J-groove dimension and give the brief determination of for future research.

Chapter 7 summarizes the results obtained in this research and describes future prospect.