

**CFD EVALUATION OF TURBOMACHINERY SECONDARY FLOW LEAK PATH AND
LABYRINTH SEAL ENTRY SWIRL**

Zenglin Guo
Research Associate

R. Gordon Kirk
Professor

Rotor Dynamics Laboratory
Mechanical Engineering Department
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061 USA

ABSTRACT

Labyrinth seals in various kinds of turbo machines often generate driving force components that may increase the unstable vibration of the rotor. In order to predict the instability of the entire system, it is important to know the flowing process within the seals and its contribution to the rotor dynamic force components. Due to the complex geometry of labyrinth seals, it is normally necessary to simplify the physical model of the problem and governing equations to obtain approximate and quick results. This leaves a space for more accurate results and also for the verification of assumptions necessary when using those simplified solutions. In this research, the ANSYS-TASCFlow, a commercial CFD program, is used to simulate leak path and labyrinth seal of two different covered centrifugal compressor eye seals. For each case, 3D models with eccentric rotor are solved to obtain the leakage flow, velocity vector, chamber pressure, average chamber swirl and the rotor dynamic force components. For the analysis of the influence by the path channel, seal alone and seal with impeller channel are solved and discussed in each case. The calculation process is discussed in detail.

Keywords: Labyrinth, seals, leakage, stability, rotordynamics