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Visualization for Investigations on Structure of Secondary Flow Vortex within Highly Loaded Turbine Cascade

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Abstract

In order to address the energy-saving and the recent environmental problems such as global warming due to CO_2 emissions, continuous efforts are required to improve the performance of the steam turbines and the gas turbines, which support the base of energy conversion. With the aim of reducing the secondary flow losses within the highly loaded turbine cascade, the authors have proposed a new idea to install the plasma actuators on the inlet wall of the turbine cascade.

To realize the high-performance concept, experimental investigations to clarify the vortex structure near the enwall of a cascade by using smoke wire technique and PIV; Particle Image Velocimetry, as a laser measurement system were carried out. And also, CFD using LES model were conducted to analyze the vortices system in detail by comparing experimental results with calculation. As a result, formation and development of the horseshoe vortex and the passage vortex within the highly loaded turbine cascade became clear through the streak of smoke generated by the wire, velocity vectors obtained from PIV measurement and LES analysis.

Moreover, on the CFD aspect, a simple numerical model of a plasma actuator is implemented, and applied to CFD computation, to investigate the effects, then this result will be discussed for future experiment which equips the plasma actuators.

Keywords*:* Turbine cascade, Secondary flow, Horseshoe vortex, Plasma actuator, Flow visualization.