World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:13, No:11, 2019

A Rotating Facility with High Temporal and Spatial Resolution Particle Image Velocimetry System to Investigate the Turbulent Boundary Layer Flow

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Abstract : A time-resolved particle image velocimetry (PIV) system is developed to investigate the boundary layer flow with the effect of rotating Coriolis and buoyancy force. This time-resolved PIV system consists of a 10 Watts continuous laser diode and a high-speed camera. The laser diode is able to provide a less than 1mm thickness sheet light, and the high-speed camera can capture the 6400 frames per second with 1024×1024 pixels. The whole laser and the camera are fixed on the rotating facility with 1 radius meters and up to 500 revolutions per minute, which can measure the boundary flow velocity in the rotating channel with and without ribs directly at rotating conditions. To investigate the effect of buoyancy force, transparent heater glasses are used to provide the constant thermal heat flux, and then the density differences are generated near the channel wall, and the buoyancy force can be simulated when the channel is rotating. Due to the high temporal and spatial resolution of the system, the proper orthogonal decomposition (POD) can be developed to analyze the characteristic of the turbulent boundary layer flow at rotating conditions. With this rotating facility and PIV system, the velocity profile, Reynolds shear stress, spatial and temporal correlation, and the POD modes of the turbulent boundary layer flow can be discussed.

Keywords : rotating facility, PIV, boundary layer flow, spatial and temporal resolution
Conference Title : ICTHT 2019 : International Conference on Thermophysics and Heat Transfer
Conference Location : London, United Kingdom
Conference Dates : November 18-19, 2019