EXPERIMENTAL STUDY OF THE IMPACT OF CORIOLIS FORCE ON THE BOUNDARY LAYER

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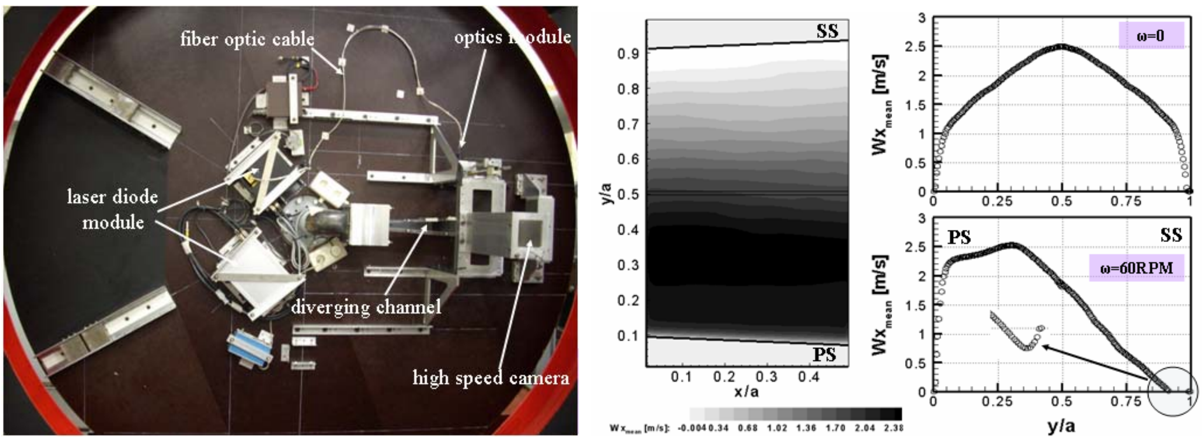
Micro gas turbines can be an alternative to the heavy and short lasting lithium batteries in a consequence of attaining very high energy density and smaller dimensions. As a result of the small dimensions, the system temperature and operating rotational speed are too high. These basic features of micro gas turbines lead some problems should be analyzed. The effects of rotation and low Reynolds number on boundary layer stability, establishment of turbulence field and generation of secondary flows are the main investigation subjects of this project. To do this, the rotating facility (see Figure 1-a) was built to measure direct relative velocity on a simplified, rotating model of the blade-to-blade passage of the centrifugal compressor.

Particle Image Velocimetry technique is employed to visualize low Reynolds number flow in a high aspect ratio, rotating, 6^o diverging channel. The experiments are carried out at the inlet and the midway (between inlet and outlet) of the channel with different Reynolds and Rotation numbers; with and without roughness.

In consequence of using high aspect ratio channel as a model, the boundary layer stability has been analyzed in the absence of secondary flows effects. The mean flow field having from all measurements showed that the flow at the inlet is not affected by rotation. The boundary layer thickness at the suction side is increasing with increasing rotational speed. The analysis of instantaneous flow evolution during rotation has showed that the formation of coherent structures is totally different than that of the stationary condition of the flow. Higher turbulence intensity distribution was observed for the tests with roughness.

The present investigation was performed to provide accurate experimental data to improve the numerical predictions. The results obtained from the present investigations provide a good insight about the effect of rotation on boundary layer, and can be used to validate numerical approaches. The analysis of this experimental study encourages us to conclude that rotation changes radically the flow topology close to wall observed in stationary condition.



(a) (b)

Figure 1: Rotating facility (a), Velocity contour and extracted velocity profiles at the midway of the channel (b)