FAST RESPONSE PRESSURE MEASUREMENTS BEHIND A COMPRESSOR ROTOR

Burak Kaplan, Turkey
Supervisor: C. H. Sieverding

Unsteady flow measurements has always been a challenge in the field of turbomachinery. In the present study, a turbomachinery application of fast response pressure measurements was performed. The flow field in the exit plane of the rotor of the R-2 compressor facility was investigated by means of pneumatic and fast-response pressure measurements. A radial traverse was done with the pressure probes along the blade height of the rotor. A NACA probe was used upstream to measure the inlet flow and a 5-hole probe downstream of the rotor to measure the exit total and static pressure, absolute pitch and yaw angle and Mach number.

The two fast response probes, the AP3-H30 (directional probe) & AP1-C25 (total pressure probe) recently designed and developed at VKI, were used for unsteady pressure and yaw angle measurements. The average values of the unsteady pressures from both fast-response probes as well as the average of unsteady yaw angle from the AP3-H30 were compared with the values taken from pneumatic measurements. Phase-locked averaging was applied to the unsteady data to obtain information about the characteristics and magnitudes of the total pressure (Fig. 1) and absolute yaw angle (Fig.2) fluctuations. The wakes formed by each blade passage were clearly seen in the phase-locked averages of the unsteady signals. At 4000 rpm, total pressure fluctuations of ± 0.2 % of inlet total pressure were found in the wake region (midspan). Yaw angle fluctuations of ±4º were obtained at midspan increasing till ±10º at the blade tip. From the unsteady total pressure and yaw angle information, the unsteady static pressure and Mach number fields were derived. Ensemble averaging was applied as well to have information about the fluctuations over one revolution of the rotor, which also gives the characteristics of each specific blade passage of the rotor.

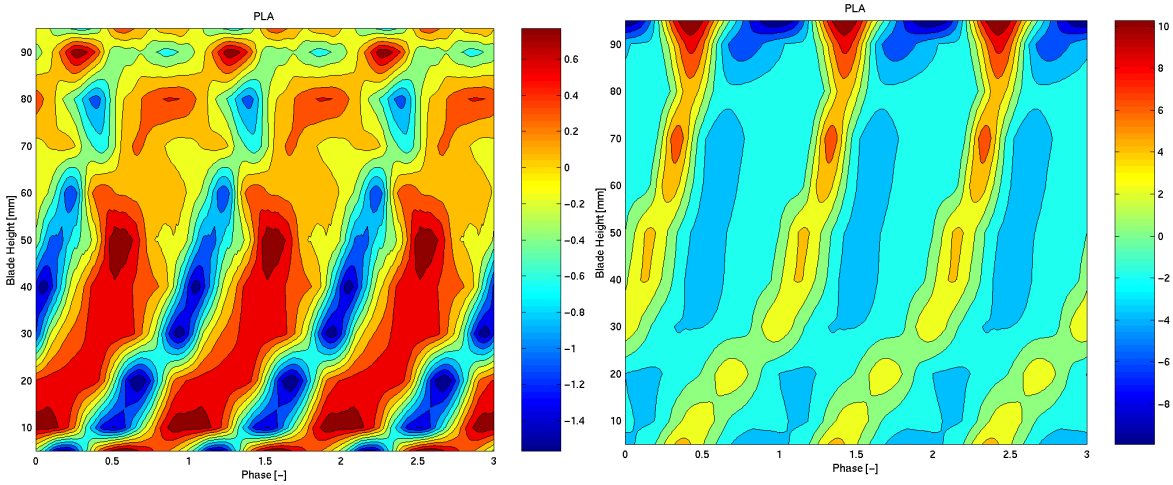

Figure 1: PLA of total pressure (AP3-H30)

Figure 2: PLA of yaw angle fluctuation (AP3-H30)