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Experimental investigation of turbine wake flow by interferometrically triggered LDV-measurements

N. MAYRHOFER, H. LANG, J. WOISETSCHLÄGER
Institute for Thermal Turbomachinery and Machine Dynamics,
Graz University of Technology, Inffeldgasse 25, A-8010 Graz, Austria
EMail: ttm@ttm.tu-graz.ac.at Fax: +43 316 873 7234 Phone: +43 316 873 7227

ABSTRACT

Interferometrically detected density fluctuations had been used to trigger two-dimensional velocity measurements by Laser-Doppler-Velocimetry (LDV) in a turbine wake flow. The experiments were carried out in four circumferential lines behind a linear arrangement of turbine profiles with a chord length of 58mm at an isentropic exit Mach number of 0.69 and a Reynolds number of $9.75 \cdot 10^5$.

Density fluctuations of the vortex street were measured by guiding the beam of a laser-vibrometer through the turbine blade cascade behind the trailing edge under observation. The so derived time-signal was conditioned by means of an analog filter and used to synchronise the LDV system. Alternatively a more advantageous way using a phase-locked-loop (PLL) was applied. As result, phase resolved measurements of particle velocities in the wake of the profile could be derived. After decomposition into turbulent and periodic fluctuation the data were visualised and prepared for comparison to numerical results.

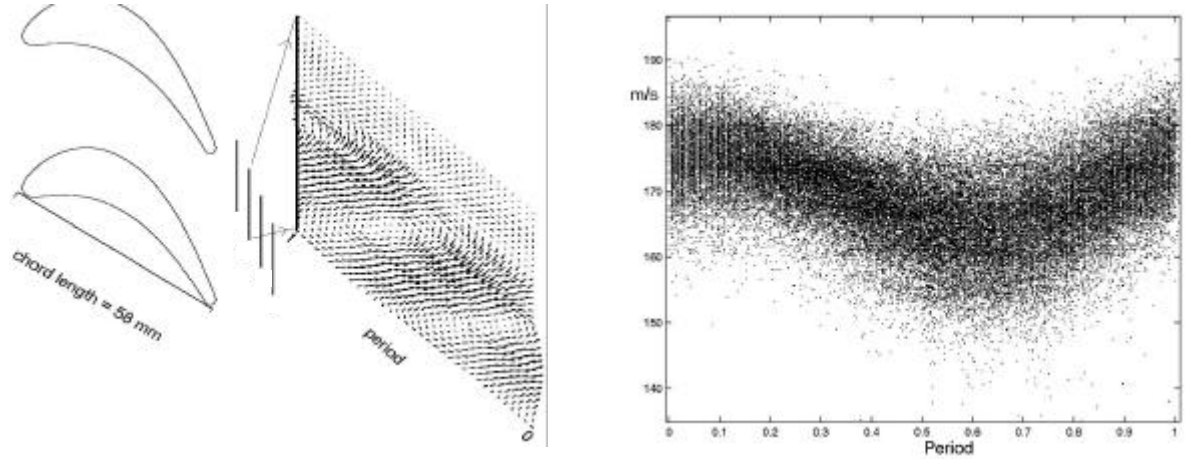

Fig. 1. Positions of the four planes for which time-resolved LDV measurements had been recorded in relation to the turbine blade profiles(left). For one plane the ensemble-averaged periodic changes of the velocity vectors are shown (middle). The time axis is plotted approximately against the direction of mean flow to show the vortices. For one position at the suction side a full LDV data set for one velocity component is presented at the right (18.3 kHz average vortex shedding frequency or 54.6 µs period). From these data time-averaged velocities as well as periodic, turbulent and total RMS were derived.