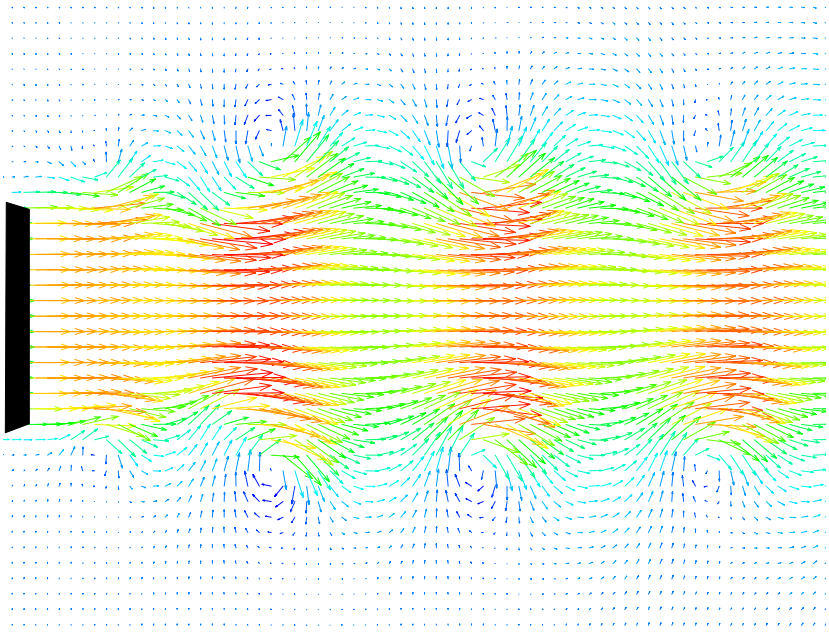
INVESTIGATION OF COHERENT STRUCTURES IN AN ACOUSTICALLY EXCITED CIRCULAR AIR JET.

Piotr Siewert, Poland
Supervisors: J.P.A.J. van Beeck & C. Schram

The main aim of the study was to investigate transport phenomena in the initial region of an acoustically excited jet. Influence of $St_D = D_{nozzle} f_{excitation} / U_{exit}$ and the excitation level on the jet mixing have been done. The plane acoustic wave generated by loudspeaker was used to excite the jet. The Linear Instability Theory was considered in order to understand the instability of the free shear layer flows. The flow visualisation was performed to investigate the shear layer instability and vortex roll-up. The 2D PIV measurements were performed and the results were processed with wavelet analysis to investigate coherent structure characteristics. Statistical quantities like mean velocity and turbulence intensity of the jet were measured using hot wire anemometry.

It was found that the rolled-up vortices in the initial region of the shear layer had tendency to pair further downstream. The pairing of vortices was found to dominate the coherent motion in the excited jet. No obvious correlation has been found between the coherent structures motion and the jet mixing or entrainment phenomena. Nevertheless it was proved that the transport phenomena in the jet were influenced by the acoustic excitation. The increase of turbulence intensity in the region of the vortex pairing was observed. The excitation with $St_D = 0.35$ was found to produce the highest increase of turbulence intensity. It is sure that the excitation, if not properly done can either suppress or increase the entrainment hence the mixing control by means of acoustic excitation is not straightforward.



Phase averaged velocity field of excited jet (PIV measurements)
The vectors coloured with U velocity contours.
U_{excit} = 6m/s; $f_{excitation}$ = 130Hz; D = 41mm; St_D = 0.85; u'/U_{excit} =2.75%