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THE GENERATION OF HIGHER LEVELS OF TURBULENCE IN A LOW-SPEED CASCADE WIND TUNNEL BY PRESSURIZED TUBES

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Many flow conditions are characterized by very large turbulence intensity. For example, turbulence intensity of up to 20 % is achieved in turbomachinery flows, due to periodic rotor-stator interaction and wake convection. Corresponding wind tunnel investigations have to simulate similar turbulence intensities, in order to reproduce the flow phenomena in a realistic manner. In particular, the laminar-turbulent transition and heat transfer are highly dependent on the free-stream turbulence level. The combination of high turbulence intensity and relatively low Reynolds number ($Re < 500,000$), as typical of turbomachinery flow, leads to highly pronounced transition effects, which considerably determine the boundary layer development and aerodynamic performance parameters. Hence, the reproduction of characteristic turbulence levels is of great importance for corresponding wind tunnel investigations.

Usually, passive turbulence grids are used for elevating the turbulence level in cascade wind tunnels. Appling a proper combination of grid parameters (grid element shape, element width, element pitch, etc.) turbulence levels up to 4 or 5 % can be achieved, as frequently reported in the literature. This is in good agreement with the results obtained by the authors with passive grids (not shown here). In order to further increase the turbulence level, an active grid has been developed. It consists of a parallel single row of circular cylinder rods with evenly distributed jet injections. The mass flow injection for each rod is continuously adjustable to produce homogeneous turbulence distributions. In

this way, turbulence intensity range of $Tu = 4$ to 9 % has been obtained in the test section. Care has also been taken to the flow homogeneity, which proved to be as challenging as the production of high turbulence levels.

The increase of the turbulence level by the turbulence generator for a Reynolds number of $Re = 60,000$ is shown in figure 1. On the left hand side the turbulence distribution without turbulence generator is displayed, whereas on the right hand side the same measurement plane is presented for $Tu \approx 8\%$. Considering the large flow distortion, which is an inherent side effect of large turbulence generation, the homogeneity of the turbulence distribution can be considered as very good.

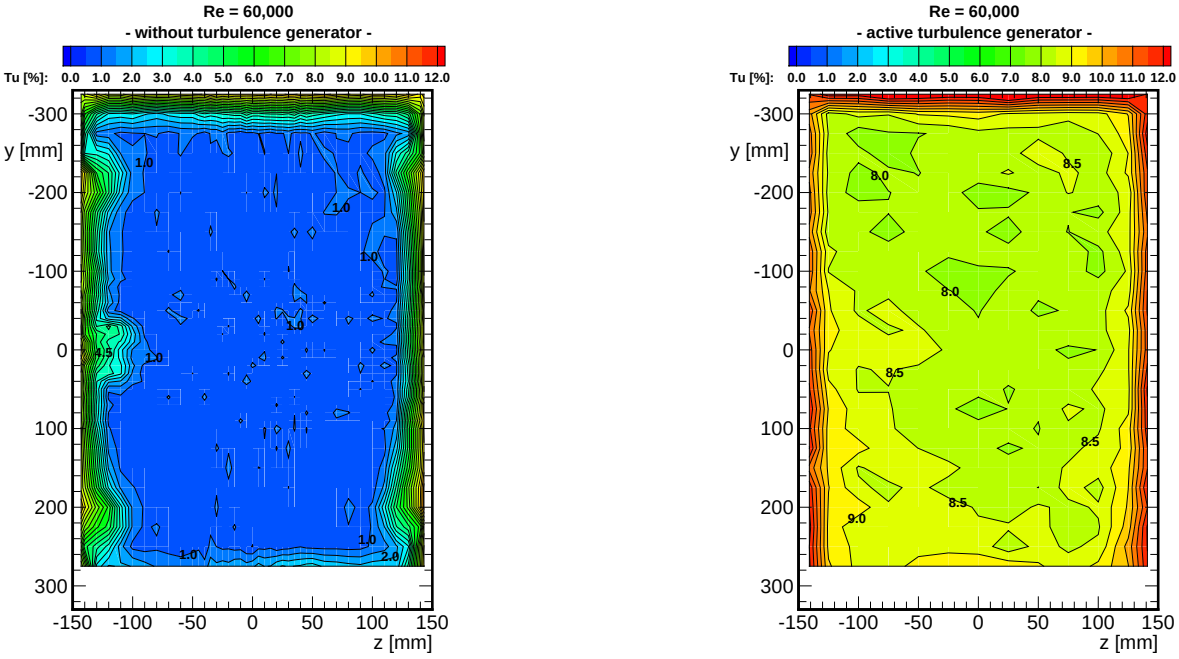

Figure 1: Turbulence intensity with and without turbulence generator in the test section of the Low Speed Cascade Wind Tunnel Braunschweig, $Re = 60,000$

Construction details and further results for different turbulence intensities as well as decay rates will be presented in the final paper.

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