Active grid generated turbulence

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The traditional method of generating turbulence in a wind tunnel is by the insertion of mechanical grids into the air flow. The major drawback are the rather small achiveable Reynolds numbers caused by low turbulence intensities of typically less than 5%. Another rather new aproach to generate turbulence is to use a so called active grid, first developed and realized by Makita in 1991 [1]. In contrast to conventional grids it consists of several horizontal and vertical axes with surmounted flaps, that can separately and independently be moved by electrical drives. Based on his pioneering work and subsequent developments we developed a similar active grid for our wind tunnel. In our work we focus on the influence of different driving signals on the generated turbulence.

The wind tunnel is a closed loop section tunnel with a cross section of 1.10 by 0.80 m^2, that can be operated with a closed or an open (Goettingen style) test section. At open section, the test section length is 1.80 m and 2.70 m at closed section. The maximum wind speed of the free flow is 50 m/s.

By the choice of an adequate static or stochastic dynamic excitation of the axes of the grid, the turbulence intensity and thus the Reynolds number of the turbulent flow can be influenced. In particular we have investigated the features of generated turbulence by the static grid (zero driving signals), by periodically excited grid and by an excitation of the active grid by numerical signals which have the intermittent structure of measured turbulent signals. It seems that if we use a turbulent-like signal as a driving force for the grid, even a turbulent flow with larger inertial range can be generated. With further methods of data analysis, structure functions and multiscale statistics grasped by reconstructed Fokker-Planck equation we investigate if an other class of turbulence, like the one of the fractal grid, can be generated by special driving signals.

[1] H. Makita: Realization of a large-scale turbulence field in a small wind tunnel, Fluid Dyn. Res. 8, 53-64 (1991)

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