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### An experimental study of fractal grid generated-turbulence using PIV

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#### ABSTRACT

In this work, the turbulence properties of fractal grids were experimentally investigated by means of 2D Particle Image Velocimetry (PIV). This work was motivated by the need to determine power coefficients for wind/tidal turbine rotor in controlled turbulent flow conditions, to compare to results typically obtained in very low turbulent tunnels which are not representative of real-world conditions. Multiscale grids have been designed guided by the results found in the existing literature to achieve a desired turbulent profile. Square pattern fractal grids were used in this study. The fractal grids were installed at the entrance of a water channel, with a test section area of  $T=0.45\text{m}^2$  cross section and 2.5m length. The experiments were run at different inlet velocities, 0.9  $\text{ms}^{-1}$  for grid N4 and 1.3 and 1.5  $\text{ms}^{-1}$  for grid N3 respectively. The background turbulence intensity of the flow in the tunnel in the absence of the fractal grid obstruction is 0.5 % in the streamwise direction. The average and fluctuating flow fields are presented and the streamwise turbulence intensity along the channel is analyzed. The position and magnitude of the peak turbulence intensity is compared with predictions from sizing rules reported in the literature and relative the future positions of test rotors in the water tunnel.

**Keywords:** Fractal square grid; Turbulence Measurement; Particle Image Velocimetry (PIV); Wind/Hydrokinetic turbine rotor.