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Evolution of the velocity gradient invariants of fractal-generated turbulence[1] RAFAEL FERNANDES, Imperial College London, BHARATHRAM GANAPATHISUBRAMANI, University of Southampton, CHRISTOS VASSILICOS, Imperial College London — An experimental study of turbulence generated by low-blockage space-filling fractal square grids was performed using cinematographic Stereo Particle Image Velocimetry in a water tunnel. Velocity gradient tensors were determined using Taylor's hypothesis and their invariants were computed at different distances downstream of the grid. It is shown that the classical tear-drop shape of the second and third invariant (Q and R) diagram is not seen throughout all measured stations but, instead, develops to the well known shape with downstream distance from the grid. Surprisingly, the averages of the Q and R remain zero throughout the measurements in space, even in highly inhomogeneous regions of the flow. The structure function achieves the 2/3 power law when conditioned on a very active sub-region of the flow, well before where the classical shape of the Q-R diagram is established, and in a non-Gaussian, inhomogeneous part of the turbulent flow. Finally, the alignment of the vorticity vector with the eigen vectors of the strain rate tensor in specific quadrants of the Q-R diagram is studied as a function of downstream position.

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