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On the Large Scale Dynamics in the Wake of a Fractal Obstacle JONATHAN HIGHAM, WERNHER BREVIS, Univ of Sheffield — In a water flume three-dimensional Particle Tracking Velocimetry is used to capture the turbulent wake of two full-width and wall-mounted obstacles: The first obstacle is a uniformly spaced array of square cylinders of same length-scale; the second is a three-iteration pre-fractal based on a the deterministic Sierpinski Carpet. Both obstacles emerge from the water surface and had the same porosity. For the description of the instantaneous vortical structures the velocity gradient tensor is analysed. It is found that whilst the largest length scales of the fractal dominated the vorticity field in the wake, the smaller length-scale within the obstacle caused intense vortical structures within the near field of the wake. To further investigate the spatio-temporal behaviour of the wake a simple and integrated use of the Proper Orthogonal Decomposition (POD) and Dynamic Mode Decomposition (DMD) is introduced. POD is used to rank the spatial structures relatable to the total variance (i.e. vorticity) while DMD is used to identify their dominant oscillation frequencies and spatial characteristics. From the POD it is clear that the largest length-scale creates spatially dominant structures, whilst the DMD extracts a set of oscillatory frequencies relatable to each fractal length-scale.

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