STUDY OF SHOCK WAVE INTERACTION WITH ARRAY OF CYLINDERS

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A comprehensive study of shock-wave propagation through array of cylinder matrix is carried out with varying the number of cylinders while keeping the similar percentage of open passage (ε_p). The relaxation length between two adjacent columns of cylinders is kept identical to study uniquely the effect of surface-to-volume ratio of the obstacle matrix. According to the recent findings of Berger et al. [1], the influence of different geometrical shapes on shock-wave attenuation is very small for higher ε_p. On the other hand, configuration with higher surface-to-volume ratio produces more oscillatory flow-field signals downstream of the matrix block. The complex shock-shock and shock-vortex interactions are well resolved by the present computation. It is being observed that after the passage of the shock through the cylinder matrix, eddies of different length scales are generated, but the later stage of shock-vortex, shocklet-vortexlet interaction are different for the two cases. Since most of the kinetic energy of the turbulent motion is contained in the large-scale structures (which is captured by Euler equations), the energy "cascades" from these large scale structures to smaller scale structures by an inertial and essentially inviscid mechanism. The analysis of PSD (power spectrum density) of the total kinetic energy globally conforms with the Richardson's inviscid cascade. An intermittent peaked PDF (probability density function) of downstream instantaneous vorticity field is obtained in the limit of $Re \to \infty$. The baroclinic production of vorticity is found to be feeble as previously mentioned by Sun and Takayama [2]. Further results including viscous effects will be included in the full-length paper.

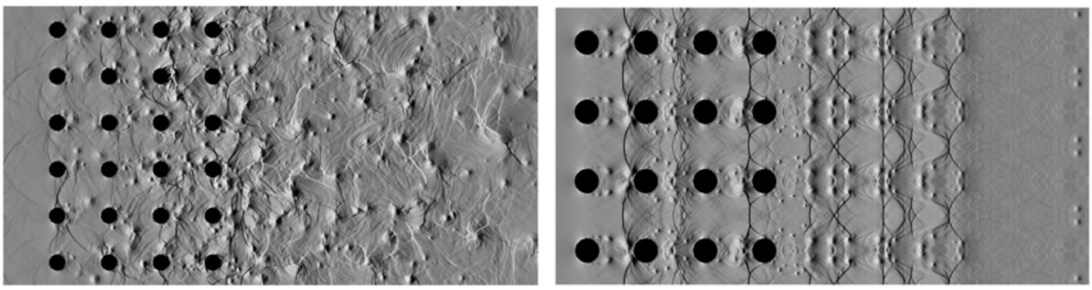

Figure 1: Numerical schlieren pictures at time t=10 s for two test cases

References

[1] S. Berger, O. Sadot, G. Ben-Dor, Experimental investigation on the shock-wave load attenuation by geometrical means, Shock waves, 20(1), pp. 29-40 (2010)

[2] M. Sun, K. Takayama, Vorticity production in shock diffraction, J. Fluid Mech. 478, pp. 237-256 (2003)