
Oscillations in Turbulence

Deepa Chikkamath^{*1,2}, Stéphane Perrard³, and Jishen Zhang^{1,4}

¹Physique et mécanique des milieux hétérogènes – Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris, Sorbonne Université, Centre National de la Recherche Scientifique, Université Paris Cité – France

²Indian Institute of Science Education and Research Mohali – Inde

³Physique et mécanique des milieux hétérogènes (UMR 7636) – Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris, Université Paris sciences et lettres, Sorbonne Université, Centre National de la Recherche Scientifique : UMR7636, Université de Paris, Centre National de la Recherche Scientifique – France

⁴Matière et Systèmes Complexes – Centre National de la Recherche Scientifique, Université Paris Cité – France

Résumé

We investigate the motion of a pendulum immersed in a grid generated turbulent flow with dimensions comparable to the integral length scale. We vary the wind velocity and the ratio between the pendulum size and the integral length scale using different grid geometries and different pendulum sizes. We obtain the baseline using the free pendulum oscillations extracting the intrinsic natural frequency and the response of the pendulum to turbulence forcing.

To characterize turbulence forcing parameters, we use an external motor to provide harmonic driving. This mechanism dominates the pendulum's response at the driving frequency, providing a controlled baseline to extract the parameters of turbulence forcing. Our results indicate that the effective natural frequency remains largely constant as turbulence intensity increases. However, the turbulence forcing is highly sensitive to the effective natural frequency. Notably, the damping rate scales linearly with the mean wind speed which suggests the applicability of linear response theory. Finally, we use the response of the pendulum to the wind to reconstruct effective forcing.

*Intervenant