Abstract Submitted
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DNS Study of Particle-Bed-Turbulence Interactions in an Oscillatory Wall-Bounded Flow[1] CHAITANYA GHODKE, SOURABH APTE, Oregon State University — Particle-resolved direct numerical simulations are performed to investigate the effects of an oscillatory flow field over a rough-bed, corresponding to the experimental setup of Keiller & Sleath (1976) for transitional and turbulent flows over a range of Reynolds numbers (95-400) based on the Stokes-layer thickness. It is shown that the roughness modulates the near-bed turbulence, distorts and breaks the streamwise horse-shoe structures, and reduces the large-scale anisotropy. A double-averaging of the flow field reveals spatial inhomogeneities at the roughness scale and alternate paths of energy transport in TKE budget. The unsteady nature of hydrodynamic forces on particles and their cross-correlations with measurable flow variables are also studied. Temporal correlations showed drag and lift to be positively correlated with a phase difference, which is approximately equal to the Taylor micro-scale related to drag/lift correlations. Spatio-temporal correlations between the flow field and particle force showed that the lift force is well correlated with the streamwise velocity fluctuations up to distances of the same order as the particle diameter, whereas pressure fluctuations are correlated and anti-correlated with the lift force in the front and aft regions of the particle.

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