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Exploring probability distribution functions best-fitting the kinetic energy of coarse particles at above threshold flow conditions

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Applying an instrumented particle [1-3], the probability density functions of kinetic energy of a coarse particle (at different solid densities) mobilised over a range of above threshold flow conditions conditions corresponding to the intermittent transport regime, were explored. The experiments were conducted in the Water Engineering Lab at the University of Glasgow on a tilting recirculating flume with 800 (length) × 90 (width) cm dimension. Twelve different flow conditions corresponding to intermittent transport regime for the range of particle densities examined herein, have been implemented in this research. Ensuring fully developed flow conditions, the start of the test section was located at 3.2 meters upstream of the flume outlet. The bed surface of the flume is flat and made up of well-packed glass beads of 16.2 mm diameter, offering a uniform roughness over which the instrumented particle is transported. MEMS sensors are embedded within the instrumented particle with 3-axis gyroscope and 3-axis accelerometer. At the beginning of each experimental run, instrumented particle is placed at the upstream of the test section, fully exposed to the free stream flow. Its motion is recorded with top and side cameras to enable a deeper understanding of particle transport processes. Using results from sets of instrumented particle transport experiments with varying flow rates and particle densities, the probability distribution functions (PDFs) of the instrumented particles kinetic energy, were generated. The best-fitted PDFs were selected by applying the Kolmogorov-Smirnov test and the results were discussed considering the light of the recent literature of the particle velocity distributions.

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