INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The continued efforts in understanding the motion of a solid object through a fluid medium has resulted in innovative designing of automobiles, aircraft, submarines etc. Similarly, the studies on the motion of a solid object through a granular medium can lead to designing vehicles or robots that can be used in rescue operations during and slides or snow avalanches or for exploring new terrains. A thorough understanding of the intruder's motion through granular medium helps in mining/drilling operations and designing automobiles that can move through sand or snow. To this end, three types of intruder's motion have been investigated: translation, oscillation and rotation. In our work, we studied the effect of the intruder's shape while it is translating through a system of circular particles. We observed that the drag force is minimally affected by the shape of the intruder provided their cross-section is kept constant. However, the lift force strongly depends on the shape of the intruder. We further studied how the shape of the granular particles affect the translatory motion of an intruder as the granular systems in practice mostly comprise of non-spherical particles. The drag force increases with an increase in the fraction of dumbbells though the total mass of a dumbbell and a disc particle is kept constant. This is due to an additional resistance offered by the dumbbells owing to their geometry. Then, we investigated the horizontal wiggling motion of an intruder in a granular medium. This work is inspired by the motion of sand-dwelling creatures which can penetrate through the sand by inducing wavy motion of their bodies. In our work, we probed the shape of the intruder on its vertical motion and the rate of vertical displacement. The larger the intruder's top surface, the greater the rate of negative vertical displacement due to the additional stress from the particles above. The smaller the intruder's bottom surface, the greater the rate of positive vertical displacement. Finally, we studied the simultaneous translation and rotation motion of an intruder through a granular mixture of disc and dumbbell particles. We noticed an inverse-Magnus effect which has been observed previously in a system of discs. The lift force, which is responsible for inverse-Magnus effect, is noticed to increase with an increase in the fraction of dumbbells.