LadHyX Seminar – May 23, 10:45

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Locomotion within granular media: insights from Low Reynolds numbers

The problem of locomotion into granular media is a challenge that very few actual technologies can defeat. However, numerous industrial and geological situations require systems able to progress within non-cohesive materials. In order to address this problem, previous researches have followed a biomimicry approach inspired by desert animals that propel into sand. These studies have rationalized the drag force experienced by these animals into the sand by adapting the Resistive Force Theory, originally developed in the context of viscous flows, to granular. Following this idea, one wonders if the modes of locomotion used by micro-organisms into viscous fluids would operate within granular materials. Locomotion in viscous fluids is ruled by the Scallop Purcell's theorem which stays that a reciprocal and time reversible motion does not lead to a net displacement. First, we will explore the case of a non-reciprocal motion with a helical filament rotating into a granular medium. The possibility to develop a small robot based on this mode of locomotion and propelling into granular media will be discussed. Then, we will consider the case of a reciprocal motion with the horizontal oscillation of a rod into a granular medium. We will see that a reciprocal motion into a granular material induces a net displacement differently from viscous fluids. The mechanisms responsible for this difference will be explored and a modification of the Resistive Force Theory will be proposed to account for these effects. Finally, this work will suggest new modes of locomotion operating into granular media and that would enhance the development of new robots useful for exploration or rescuing missions.