PHYSICAL MATHEMATICS SEMINAR

Bio-Inspired Digging in Granular Materials

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ABSTRACT:

There are many situations in which a continuum view of granular systems does not fully capture the relevant mechanics. In order for engineers to be able to design sys- tems for transporting granular materials, there needs to be an understanding of the mechanics of granular systems and how their non-continuous behavior affects their dynamics. Inspired by plant roots growing in granular substrates, two elements of the plant roots, mechanical flexibility and an actuated tip, were used to create robotic diggers to quantify the associated savings in digging energy. Increasing the mechanical flexibility of the digger was shown to result in energy savings of more than 50% when decreasing the bending modulus by one order of magnitude. However, large variations in the data were observed as a result of the inhomogeneity of the granular system. These variations were quantified and were consistent with previous literature regarding forces in granular systems. Also, a numerical model was created that demonstrates that the increase in digging efficiency can be attributed to the flexibility of the digger. Experiments with diggers whose tip orientation cycled from side to side show that it is more energy-efficient to dig with this active tip only if the energy used to create the changing tip orientation is less than 2.5 × 10−5 J per mm dug.

TUESDAY, OCTOBER 4, 2011
2:30 PM
Building 2, Room 105

Reception at 3:30 PM in Building 2, Room 290
(Math Dept. Common Room)

http://math.mit.edu/pms

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