ME Seminar

Internal actuation and unconventional locomotion

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ABSTRACT

Mobility in robots is usually achieved by a few common means; with a few exceptions these are wheels or legs in ground robots, propellers in flying robots, articulated tails or fins and propellers in swimming robots. However less explored is the means by which internal actuators or degrees of freedom, that do not directly interact with the environment, produce locomotion. Periodic motion of an internal body such as a rotor can produce a variety of gaits. In this talk I will discuss four different physical problems. In the first, periodic oscillations of an internal rotor inside a nonholonomic system, a Chaplygin sleigh, leads to limit cycles in a velocity space and a serpentine motion in the physical space. When the body has an additional passive tail, these limit cycles can undergo bifurcations resulting in different gaits. In the second example the oscillations of a rotor inside a Joukowski foil submerged in water creates a reverse Karman wake and leads to fish-like motion. In the third example, high frequency internal vibrations enable a small body with bristles to propel itself due to stick-slip motion or climb pipes and navigate a pipe network. In the last example, oscillations of an internal rotor enables a body to jump. While the mechanics of the four examples differ, the common theme is that of the motion enabled by internal degrees of freedom.

ABOUT THE SPEAKER

Phanindra Tallapragada is an associate professor of mechanical engineering at Clemson University. He obtained his Ph.D in Engineering Mechanics from Virginia Tech in 2010 and did post doctoral research at the University of North Carolina Charlotte. Earlier he obtained his B.Tech and M.Tech in Civil Engineering from the Indian Institute of Technology, Kharagpur. He joined Clemson University as an assistant professor in 2013. His research interests are in dynamical systems and bioinspired locomotion related to terrestrial motion, fish-like swimming, low Reynolds number swimming and operator methods for transport and manipulation in dynamical systems.

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