ICTAS

NEW HORIZONS

SEMINAR SERIES

Engineered living flagellum

For the last few decades, engineering has produced marvelous machines and devices. With increasing understanding of living cells, there are possibilities of developing biological machines where engineering precision meets the variability of life. Can order emerge from such variability and chaos? If so, then one can envision machines with unprecedented capabilities, as they would carry the footprints of the evolutionary journey of life. Here, we demonstrate an elementary biological machine. A large family of micro-organisms such as bacteria and spermatozoa wag or twist hair-like flagella to swim. At this small scale, locomotion is challenged by large viscous drag and negligible inertial forces. The organisms must generate time irreversible deformation of their flagella to produce thrust. Mimicking this strategy, we developed a self-propelled, microscale flagellar biohybrid swimmer by combining a unique fabrication and cell culture technique with a slender body hydrodynamics model [1]. Our swimmer consists of a PDMS filament shaped like a spermatozoa with a short, rigid head and long, slender tail on which cardiomyocytes are selectively cultured. The cardiomyocytes contract and bend the filament. The bending wave travels towards the tail end of the filament generating a fluid drag, which acts as a thrust to propel the swimmer forward against its longitudinal drag. The swimmer demonstrates the feasibility of an autonomous synthetic biohybrid swimmer at small scale that can be incorporated into more complex designs.

[1] Nature Communications, Jan 17, 2014, DOI:10.1038/ncomms4081

ABOUT THE SPEAKER

Dr. Taher Saif received his BS and MS degrees in civil engineering from the Bangladesh University of Engineering and Technology and from Washington State University in 1984 and 1986, respectively. He obtained his Ph.D. degree in theoretical and applied mechanics from Cornell University in 1993. He worked as a Post Doctoral Associate in Electrical Engineering and in the National Nanofabrication Facility at Cornell University from 1993-97. He joined the Department of Mechanical Science and Engineering at the University of Illinois at Urbana-Champaign in 1997. He is currently the department's Gutgsell Professor. His current research includes mechanics of neurons and cardiac cells, development of biological machines, and electro-thermo-mechanical behavior of nanoscale metals and semiconductors. His research is supported by the National Science Foundation and the National Institute of Health.

FRIDAY, APRIL 18, 2014

3:00 - 4:00 pm, 310 Kelly Hall

www.ictas.vt.edu

VirginiaTech

Institute for Critical Technology and Applied Science