Center for Theoretical Biological Physics

SEMINAR

"Multiscale modeling in Biology and Medicine"

Mark Alber, PhD

University of Notre Dame

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12:30 - 1:30 PM

BRC, 10th Floor, Rm 1060 A/B

Abstract: The ability of animals to self-organize into remarkable patterns of movement is seen throughout nature from herds of large mammals, to flocks of birds, schools of fish, and swarms of insects. Remarkably, patterns of collective movement can be seen even in the simplest forms of life such as bacteria. M. xanthus are common soil bacteria that are among the most "social" bacteria in nature. In this talk clustering mechanism of M. xanthus will be described using combination of experimental movies obtained using a novel high-resolution, time-lapse microscopy approach and model simulations [1]. Population of bacteria P. aeruginosa, main infection in hospitals, will be also shown to propagate as high density waves that move symmetrically as rings within swarms towards the extending tendrils. Biologically-justified cell-based multiscale model simulations suggest a mechanism of wave propagation as well as branched tendril formation at the edge of the population that depend upon competition between the changing viscosity of the bacterial liquid suspension and the liquid film boundary expansion caused by Marangoni forces [2]. The model predictions of wave speed and swarm expansion rate as well as cell alignment in tendrils were confirmed experimentally. In the second half of the talk a three- dimensional multiscale modeling approach will be described for studying fluid–viscoelastic cell interaction during blood clot formation. Also, the role of the fibrin network in protein transport will be examined by integrating experiments in microfluidic devices with the hemodynamic blood clot model.

C.W. Harvey, F. Morcos, C.R. Sweet, et al. [2011] Physical Biology 8, 026016.

H. Du, Z. Xu, M. Anyan et al. [2012] Biophysical Journal 103(3), 601-609.

O.V. Kim, Z. Xu, E.D. Rosen, M.S. Alber [2013] PLoS Computational Biology 9 (6), e1003095.