Cleveland State University
College of Science

COLLOQUIUM

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Chaos and Levy walks in swarming bacteria

Friday November 2nd at 3pm in RT 1516

Bio: Gil got his Ph.D. in Mathematics from the The Courant Institute (NYU) in 2006 and continued on to a postdoc position at the University of Texas at Austin. He is currently an Associate Professor in the Department of Mathematics at Bar Ilan University. His research interests are in Mathematical Biology, Numerical Analysis, and Physics of Biological Systems.

Abstract: Bacterial swarming is a collective mode of motion in which cells migrate rapidly over surfaces. Swarming is typically characterized by densely packed groups moving in coherent patterns of whirls and flows. Recent experiments showed that within such dense swarms, bacteria are performing super-diffusion that is consistent with Levy walks – random processes in which the Gaussian central limit theorem fails. We present a simple model of a spheroidal, self-propelled particle, moving in the effective, vortex-like flow generated by all other bacteria. Mathematically, the model presents a new mechanism for Levy walks in chaotic maps that are reversible but not volume preserving. Levy walking emerges from sticking close to regular, fractal-like areas with multiscale periodicities. A bifurcation separates a chaotic, super-diffusive regime and a regular, ballistic one. Biologically, it explains how cells can fine-tune the geometric properties of their trajectories.

Joint work with Avraham Be'er (BGU) and Andy Reynolds (Rothamsted Research, UK).

Refreshments at 2:30pm in RT 1517