

Department of Mathematical Sciences welcomes

Silas Alben University of Michigan



**NOTE TIME CHANGE
DUE TO 2 SPEAKERS
THIS WEEK.**

November 22, 2019

Hosted by:
Prof. Luoding Zhu

Tea begins at **2:30**
in LD 259

Research Topic
begins at **3:00**
in LD 229

Dynamics of model snakes and elastic sheets

ABSTRACT:

We address two topics related to locomotion and soft robotics. The first is the sliding locomotion of model snakes. Snakes' bodies are covered in scales that make friction anisotropic, and allow for sliding locomotion with an undulatory gait, for example. Isotropic friction is a simpler situation (that arises with snake robots, for example) but is less understood. We compute time-harmonic motions of three-link bodies and find that local optima for efficiency involve static friction to some extent. We then propose a class of smooth body motions that can achieve optimal efficiency for both isotropic and anisotropic friction.

The second topic is an efficient method to simulate the dynamics of thin elastic sheets, motivated by applications to active gels and self-assembly. We present semi-implicit time stepping algorithms to improve the time step constraints that arise in explicit methods. For a triangular lattice discretization, our semi-implicit approach is stable for all time steps. For a more general finite-difference formulation the analogous approach is stable for time steps two to three orders of magnitude greater than for an explicit scheme. We study a model problem with a radial traveling wave form of the sheet's reference metric, and find transitions from quasi-periodic to chaotic dynamics as the sheet thickness is reduced, wave amplitude is increased, and a damping constant is reduced.

ABOUT THE SPEAKER:

Silas Alben is an applied mathematician working in fluid and solid mechanics inspired by biolocomotion. Professor Alben received his A.B. from Harvard in 1999 and his Ph.D. from Courant Institute at New York University in 2004. Following a postdoc at Harvard and an assistant professorship at Georgia Tech, he joined the Department of Mathematics at the University of Michigan in 2012. He is the recipient of a Sloan Fellowship and funding from the National Science Foundation and Air Force Office of Scientific Research.

