FACULTY OF ENGINEERING
UNIVERSITY OF ALBERTA

Mechanical Engineering

Seminar

In Conjunction with Applied Mathematics Institute

Catenaries in Viscous Fluid

Presenter: James Hanna
Virginia Tech
Department of Biomedical Engineering and Mechanics

Friday, March 13th at 2pm
Room: MecE 4-1

Abstract

This talk is about certain dynamical equilibria of curves related to towed cables, sedimenting filaments, and other marine, microfluidic, or industrial structures. I will present analytical results detailing the configurations of a translating and axially moving string subjected to a uniform body force and local, linear, anisotropic drag forces. Generically, these configurations comprise a five-parameter family of planar shapes determined by the ratio of tangential (axial) and normal drag coefficients, the angle between the translational velocity and the body force, the relative magnitudes of translational and axial drag forces with respect to the body force, and a scaling parameter. This five-parameter family of shapes is, in fact, a degenerate six-parameter family of equilibria in which inertial forces rescale the tension in the string without affecting its shape. Each configuration is represented by a first order dynamical system for the tangential angle of the body, which can be classified by the presence and location of fixed points and poles in the corresponding phase portrait. I will also discuss the behavior of the tension in the string, which can display qualitatively different behavior even between similar configurations. All of this information will be conveyed through colorful cuts and projections of the parameter space.