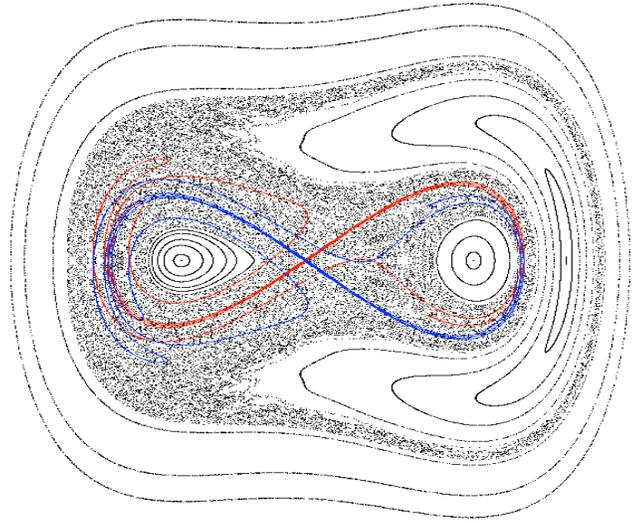


Spring 2014 Course Announcement: ESM 6314 Advanced Dynamics

Description

The objective of this course is to give the student advanced theoretical, semi-analytical, and computational tools for the analysis of dynamical systems, particularly mechanical systems. Building off of Intermediate Dynamics (ESM 5314), we discuss the geometry and analysis of mechanical systems at a more advanced level. We also consider the sets of possible motion and behaviors of mechanical systems (trajectories in phase space), which will take us into some topics of nonlinear dynamics, such as chaos, invariant manifolds, center manifolds, energy surfaces, lobes, tubes, and basins of attraction. You will be expected to do some computations, so prior familiarity with MATLAB or Mathematica is a plus.



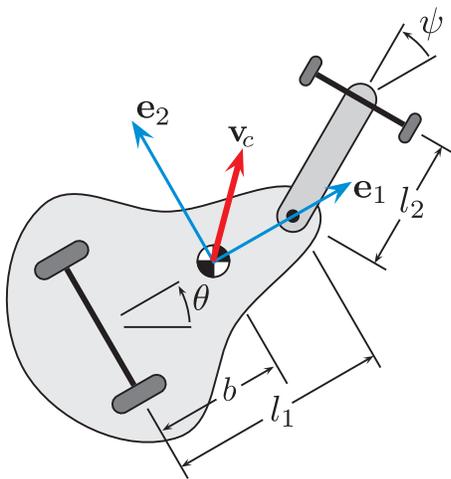
Final Course Report and Short Presentation

The course grade is based on homework (67%) and a final report and presentation (33%). For the final course report, we may pick a different format compared to previous years. You will be expected to apply techniques learned in this course to a system of interest to you, which will involve numerical computations. A written report will be submitted, similar in format to a conference paper, due near the end of the course, which will be refereed by the other students. A short presentation will be made to the class.

Some Topics to be Covered

Variational principles (e.g., principle of critical action) which give rise to mechanics
Hamiltonian mechanics, Poisson brackets, canonical transformations, action-angle variables
Configuration space, configuration manifold, phase space, tangent bundles
Lie group representations of mechanics, for example, rigid-body motion
Equilibria, stability, Poincare maps, Floquet theory
Invariant manifolds, separatrices, phase space transport, chaos
Transformations to simplify and classify systems of ODEs, e.g., normal forms

Center manifolds and bifurcations
Periodic systems, two degree-of-freedom systems, multi-degree-of-freedom systems
Mechanical systems and their special mathematical structure
Other topics as time allows or as requested



Instructor: Shane Ross. You can email if you have questions about what the course will cover
sdross@vt.edu

