Math 181: Dynamical Systems

Spring 2019

Prof. Jon Jacobsen
Harvey Mudd College

This course is aimed at newcomers to nonlinear dynamical systems, which are systems that evolve over time. The presence of nonlinearities guide our approach towards qualitative rather than quantitative questions, with an emphasis on the underlying geometric behavior. In addition to being of interest in their own right, dynamical systems arise naturally as mathematical models from many disciplines including biology, chemistry, ecology, engineering, physics, and physiology. This course is an introduction to and survey of characteristic behaviors of dynamical systems. Applications will be an integral part of the course.

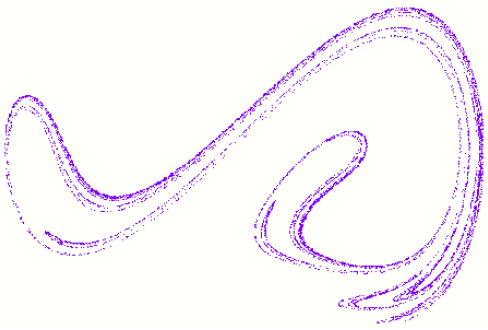
Sample topics include:

- ODE's on the line and circle (Fixed points, stability, bifurcations, oscillations)
- Systems of ODE's (Phase plane analysis, stable and unstable manifolds, fixed points and linearization, topological equivalence, homoclinic and heteroclinic orbits)
- Closed Orbits (Poincaré-Bendixon theorem)
- Bifurcation Theory (Hopf bifurcation, bifurcations of closed orbits)
- Chaos Theory (Iterated Maps, Symbolic Dynamics)
- Strange Attractors (Smale Horseshoe, Lorenz Butterfly, Henon Attractor)

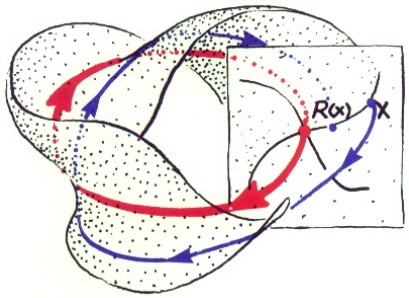
Text: S. Strogatz, *Nonlinear Dynamics and Chaos, with Applications to Physics, Biology, Chemistry, and Engineering* (any edition is ok)

Class Time: TR 9:35 - 10:50 am, Shan 3485.

Prerequisites: Familiarity with single & multivariable calculus, linear algebra, and differential equations (e.g., Math 65) or permission of the instructor.



Poincaré Section for Duffing Model



Poincaré Return Map on Strange Attractor