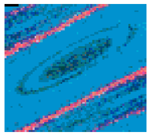
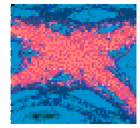


Math 496-2



Nonlinear Dynamics and Chaos

Instructor	Dr. Keith Promislow, Wells Hall D 212, kpromisl@math.msu.edu
Grading	Homework 20%, Project 20%, Midterm 20%, Final Exam 40%
Text	S. Strogatz, Nonlinear Dynamics and Chaos, Addison Wesley, 1994.
Prereq	Mth340, Mth309 or Mth314, Mth421 or Permission of instructor.

This course serves as an introduction to the exciting field of dynamical systems with an emphasis on applied models. Nonlinear differential equations and iterative maps model a beating heart, tumor growth, animal conflict, ecological systems, as well as mechanical, electrical, and economic oscillations. Through linear and nonlinear techniques we will analyze the behavior of the proposed models with emphasis on prediction of qualitative change (aka Bifurcation).

1: Ch 2 & 3	<u>Introduction to Bifurcation</u> One dimensional systems, fixed points and stability. Saddle node, trans-critical, super-critical and sub-critical pitchfork bifurcations.
2: Ch 10	<u>1D Maps</u> Maps, chaos, chaotic maps, Lyapunov exponents, area preserving maps and renormalization methods
3: Ch 5, 6 **Ch 7**	<u>Two dimensional systems and Limit Cycles</u> Linear systems, Jordan canonical forms, phase plane analysis, hyperbolic fixed points, nonlinear centers, index theory, limit cycles, periodic orbits, Poincaré-Bendixon, global attractors.
4: Ch 8	<u>Bifurcation in 2D</u> Sub- and super-critical Hopf and homo-clinic bifurcations in 2D, Center manifold reduction, Poincaré Maps.
5: Ch 9, 12	<u>Higher dimensions and Chaos</u> 3D+ continuous dynamical systems, Lorenz equations, 2D maps, homoclinic tangles.

References:

Applications of Center Manifold Theory, by Jack Carr, Springer-Verlag 1981.
Nonlinear Oscillations, Dynamical Systems, and Bifurcation of vector fields, by J. Guckenheimer and P. Holmes, Springer 1983.