Nonlinear Phenomena: Homework 6

Reading: §8.1-8.2, 9.2-9.4, 10.2-10.3

Due June 6, 2013

Problem 1 (Bifurcations Revisted: Now in 2D)

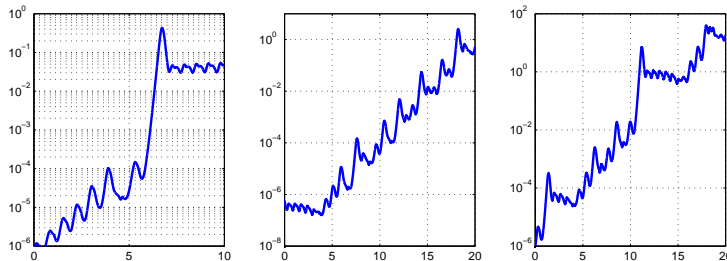Strogatz 8.1.6, 8.1.7

Problem 2 (Hopf Bifurcations)

Strogatz 8.2.13, 8.2.14, 8.2.15 (Hint: see 8.2.5., with answer at back of book.)

Problem 3 (Lorenz Equations)

Strogatz 9.2.2, 9.2.6. (Hint: partial answer for 9.2.2 at back of book...)

Problem 4 (Chaos on a Strange Attractor)

Strogatz 9.3.8, 9.3.9 (Hint, see example plots, below.)

Above are three example plots of $||\delta||$ vs t (in seconds), shown on semilogy axes, where the norm of δ is: $||\delta|| = \sqrt{(x - \tilde{x})^2 + (y - \tilde{y})^2 + (z - \tilde{z})^2}$. (See also Lecture 16 notes.) For 9.3.9, simulate the Lorenz system dynamics for a while, to get "close" to the attractor. Then, simulate from this end point and from a point a tiny distance away. Use 10 or 20 seconds of data (as in these plots). Note particular plots will vary significantly (as shown here!). You can "pick off" λ (The Lyapunov exponent) just from these plots alone, for partial credit.

Problem 5 (1D Maps (Return Maps), Revisited)

Strogatz 9.4.2, 10.3.4