Dynamical Systems Homework

Sara Schneider

April 9, 2017

I will discuss the Lorenz System. The Lorenz system is a 3-dimensional system with 3 parameters, σ, ρ, β. Here is the equation for this system:

$$\frac{dx}{dt} = \sigma(y - x)$$
$$\frac{dy}{dt} = x(\rho - z) - y$$
$$\frac{dz}{dt} = xy - \beta z$$

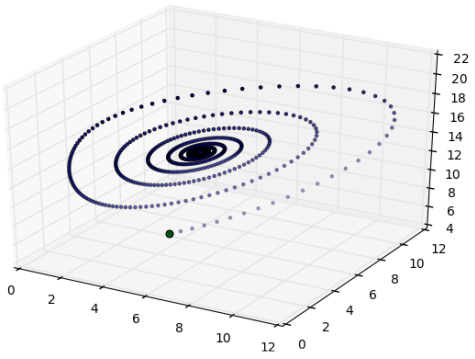

Figure 1: Lorenz system for $\sigma = 30$.
Figure 1)

Figure 1 **??** shows the phase portrait of the system for the parameter values $\sigma = 30$, $\rho = 15$, $\beta = 7/3$, and initial condition $(4, 5, 5)$. The times were set to (0, 10, 0.1). This is essentially showing the first half of the Lorenz attractor.

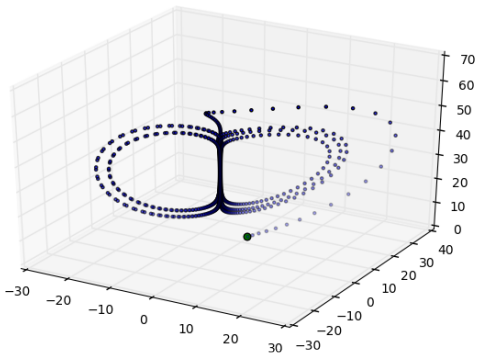

Figure 2: Lorenz system for $\sigma = 40$.
Figure 2)

Figure 2 **??** shows the phase portrait of the system for the parameter values $\sigma = 40$, $\rho = 35$, $\beta = 8/5$, and initial condition $(4, 5, 5)$. The times were set to (0, 10, 0.1). This figure does not

have the wells we're used to seeing in the Lorenz attractor, such as in Figures 1 and 3, but it can be clearly visualized how regardless of this the attractor is being brought back around towards the phase states.

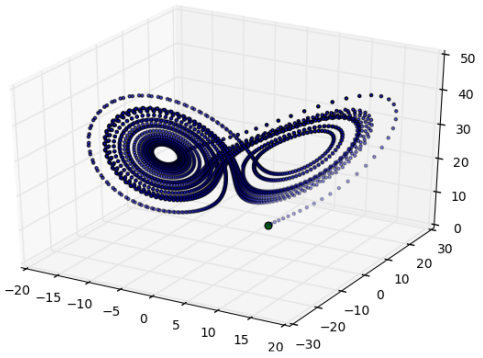

Figure 3: Lorenz system for $\sigma = 10$.
Figure 3)

Figure 3 shows the final phase portrait of the system for the parameter values $\sigma = 10$, $\rho = 28$, $\beta = 8/3$, and initial condition $(4, 5, 5)$. The times were set to (0, 30, 0.1). By examining these three figures, you can get a clearer sense for how this system unfolds over time!

(Note: Whenever I try to "ref" my figures, it pops up with ?? instead of what the figure I'm referring to, such as in Figures 1 and 2. I've tried moving things around, brackets versus parentheses, etc. and this doesn't seem to impact the issue.)