Lyapunov based Nonlinear Control - Assignment1

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1 Problem

simulate the following system

$$\ddot{x} + 0.1\dot{x} + x^5 = 6\sin t$$

for two set of initial conditions

$$x_0 = 2, \dot{x}_0 = 3$$

and

$$x_0 = 2.01, \dot{x}_0 = 3.01$$

2 Solution

Note that the given two initial conditions are almost identical.

As shown in Figure 1 and Figure 2, the responses of the system to the two initial conditions nearly coincide within a certain period of time (about 25s). But after that, the responses become apparently different from each other, as shown in Figure 3 and Figure 4.

It is due to chaos in the system caused by the high nonlinearity in x_5.

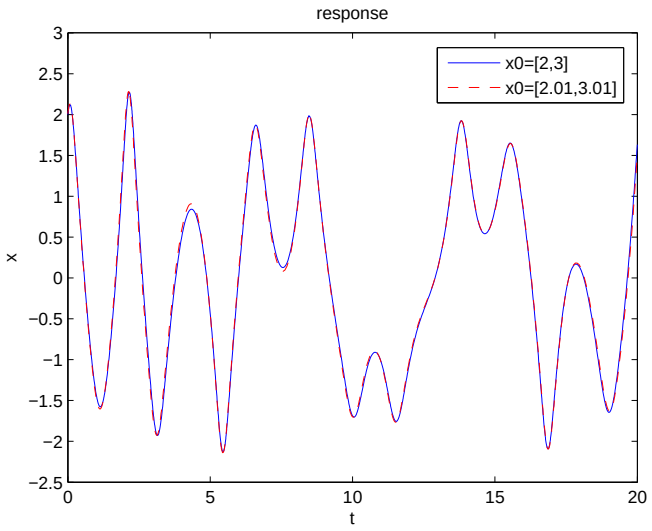

Figure 1: the response when system runtime is 20s.

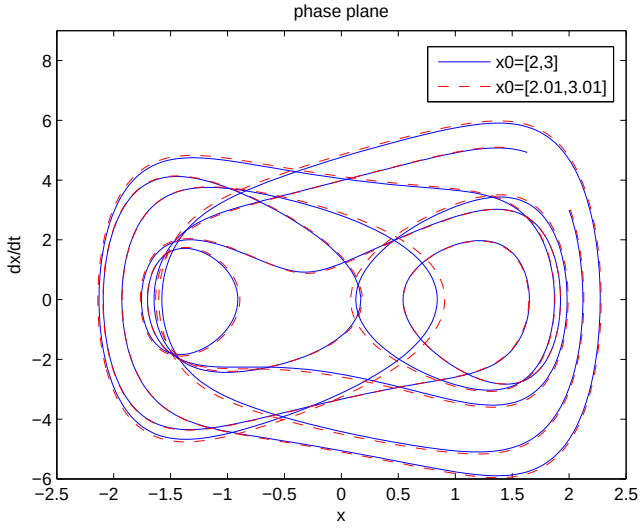

Figure 2: the phase plane when system runtime is 20s.

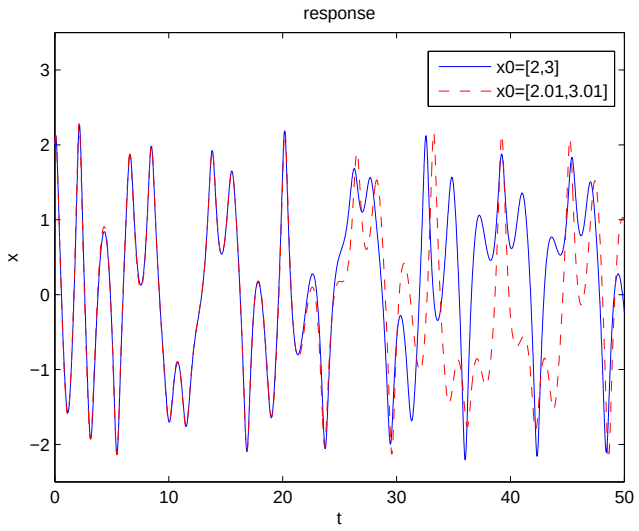

Figure 3: the response when system runtime is 50s.

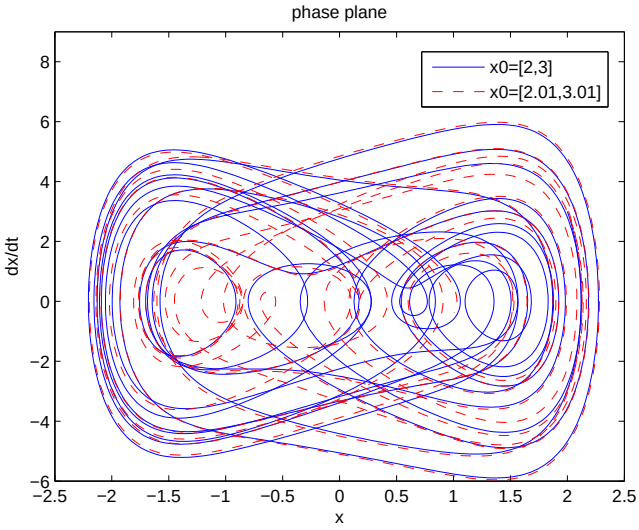

Figure 4: the phase plane when system runtime is 50s.