Homework Set #5

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Abstract

Pellentesque tincidunt lobortis orci non venenatis. Cras in justo luctus, pulvinar augue id, suscipit diam. Morbi aliquet fringilla nibh, vel pellentesque dui venenatis eget. Orci varius natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Donec ultricies ultrices magna gravida porta.

Introduction

Examining the system of a particle in an quartic electric potential has yielded some interesting results.

Bifurcation

First, a bifurcation diagram was made for a wide range of values for the driving force gamma from 0.0 to 1.25.

There are a few points of interest to look at on this diagram. Around gamma = 0.8, there is section where the system looks interesting. If we zoom in on that area we can see what's going on.

1 Gamma = 0.8

From Fig. 2 we can see that there is a split from period 3 to period 6 and back to period 3 before becoming chaotic. From the figure it is hard to determine exactly what period they are. Examining an individual value of gamma = 0.8, we can see the state space.

Examining Fig. 3 let's us see that the system seems to oscillate around two equilibrium points, at 1 m and -1 m. It is still unclear what exactly the period of this is so we can look further into this by examining the Poincare Section.

After viewing the Poincare section we can conclude that it is indeed a period six oscillator.

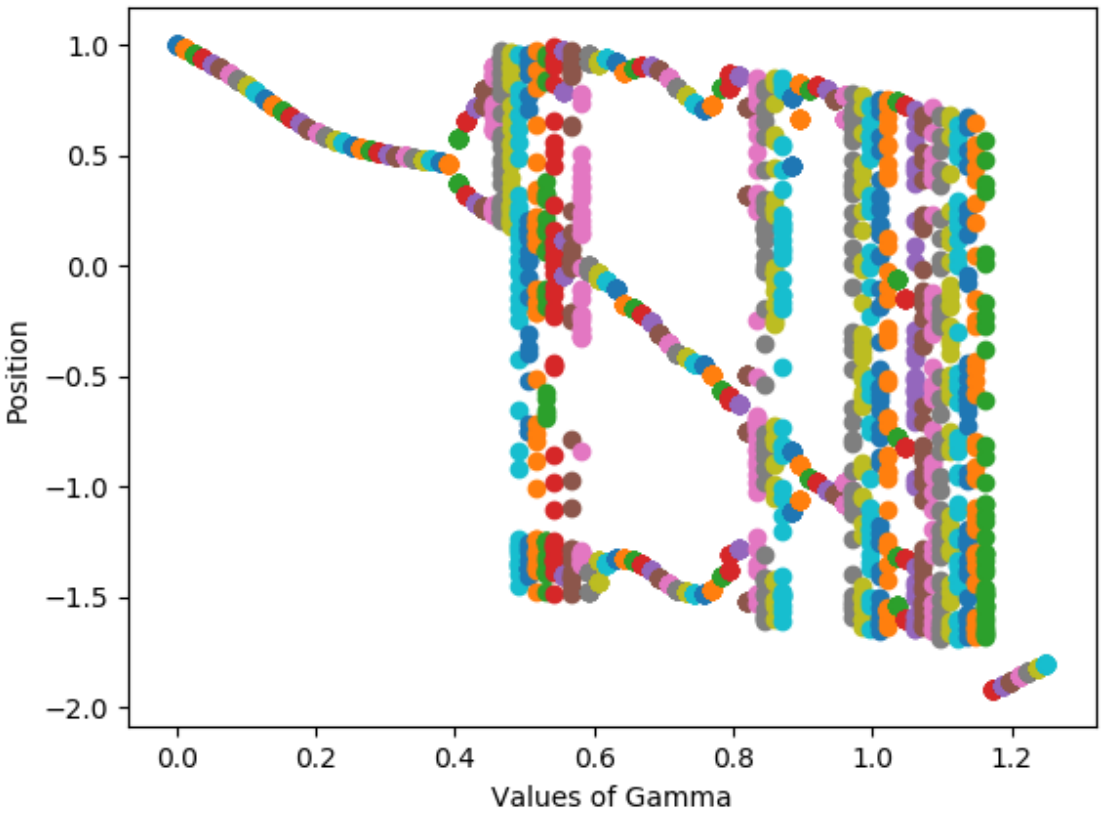


Figure 1: Wide range bifurcation diagram

Chaotic Sytem

If we increase the driving force a little further we will reach a chaotic system.

Analyzing this we see that in general, the system seems to be orbiting the same equilibrium points as the period 6 system. If we allow the system to run for longer, we can see the boundary that encloses the volume of state space that the system is allowed to occupy. The particle cannot leave this boundary.We can also see some sections that are still empty. These may be places that the particle is less likely to be found than the more filled in areas.

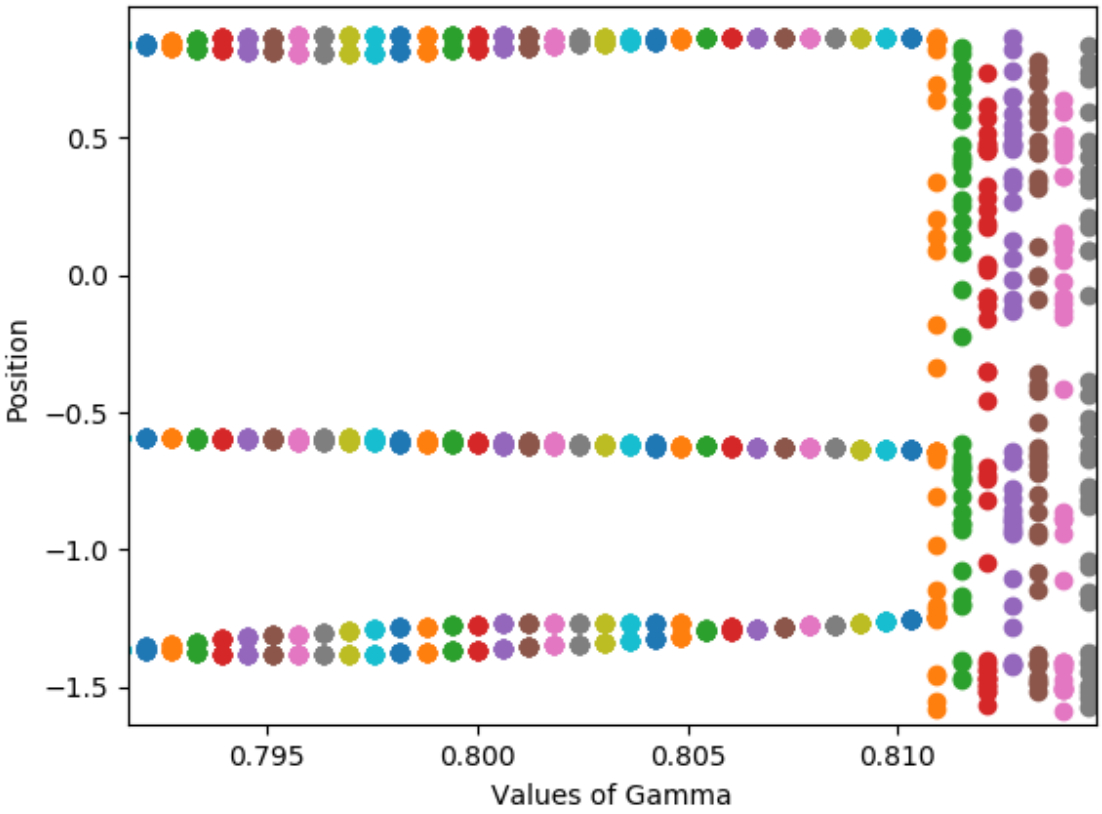


Figure 2: Bifurcation Diagram around .8

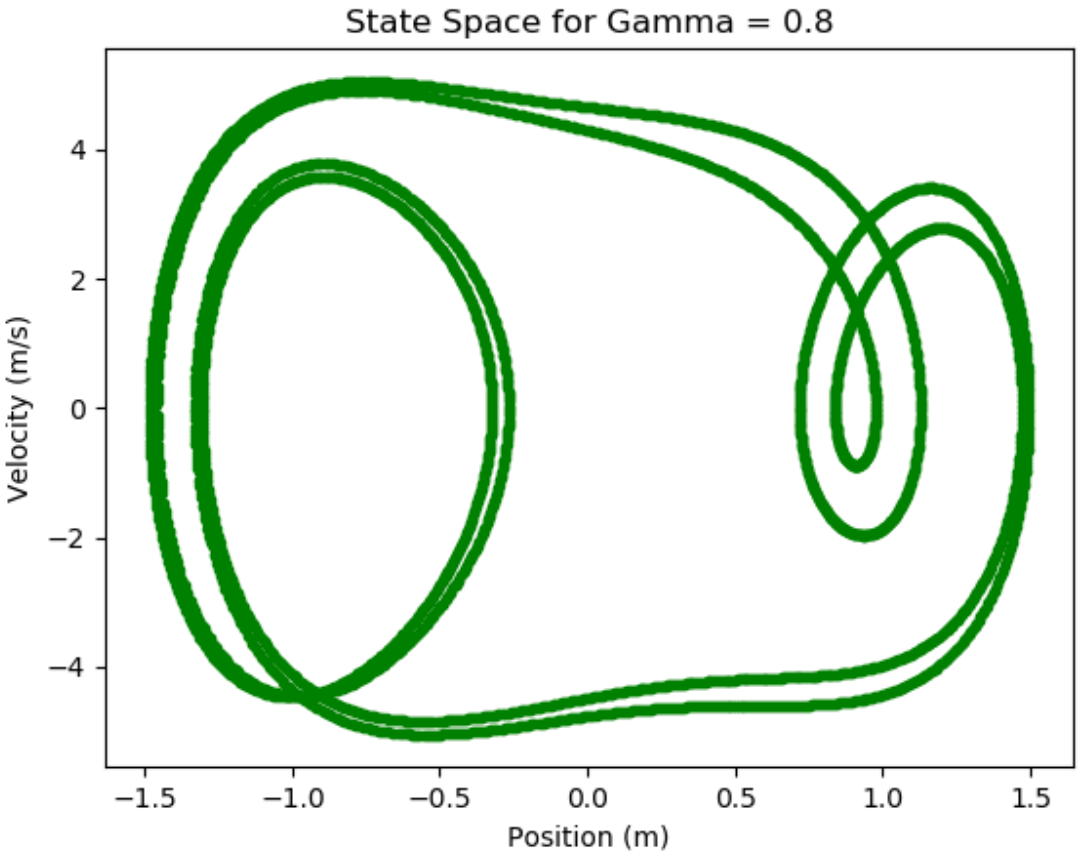


Figure 3: State Space Diagram

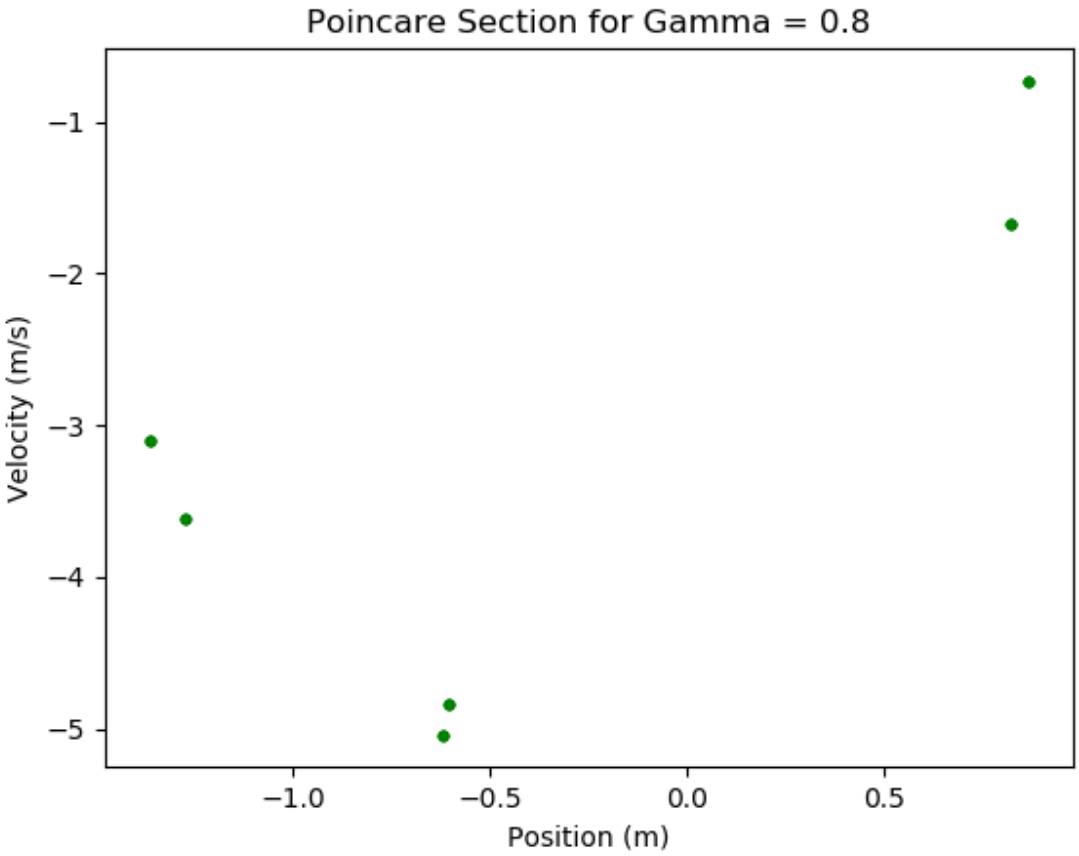


Figure 4: Poincare Section

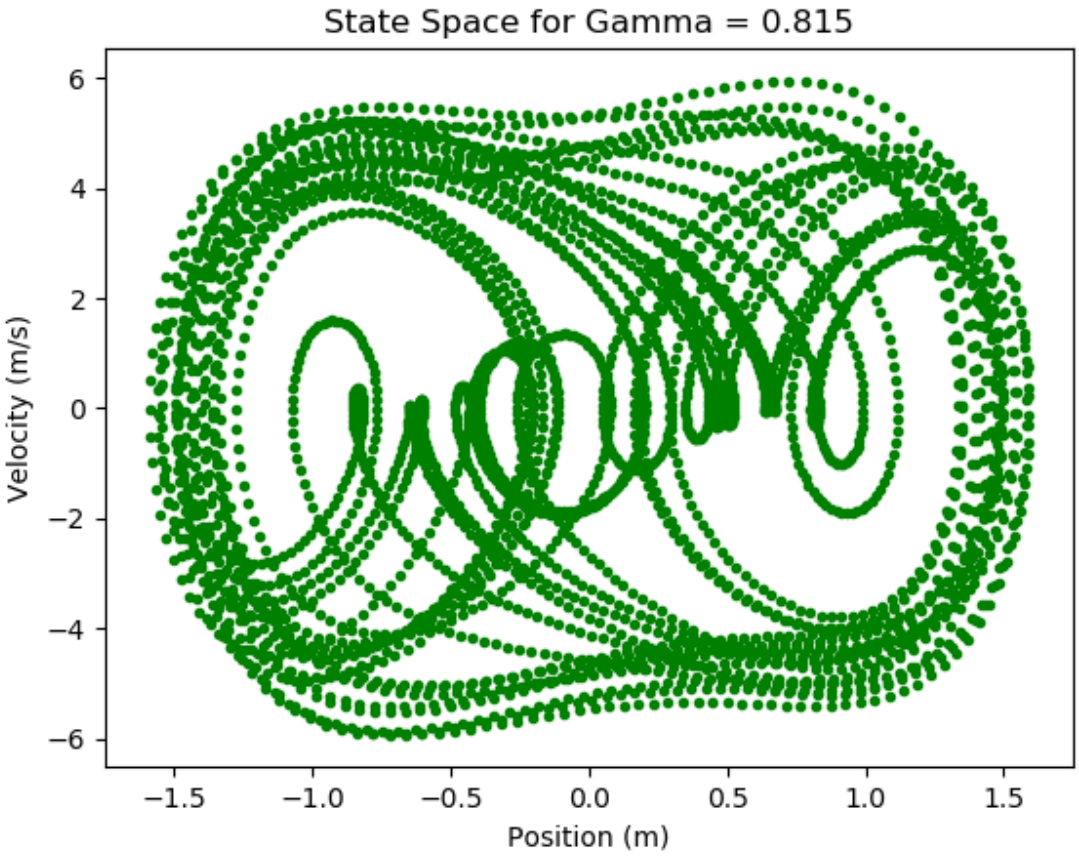
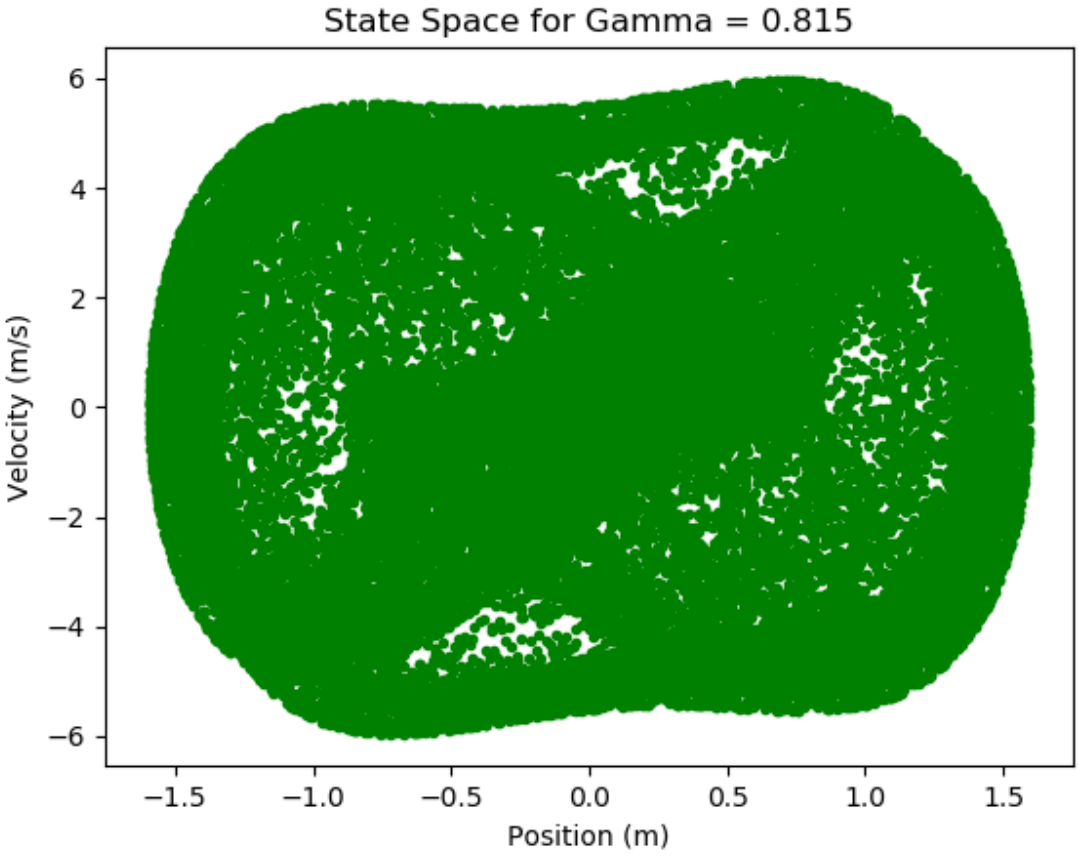


Figure 5: Chaotic System


State Space for Gamma = 0.815
Velocity (m/s)
Position (m)
6
4
2
0
−2
−4
−6
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5