Characterizing Choas of a Quartic-Potential Voltage System

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Abstract

The system was evaluated in a bifurcation diagram that held all parameters constant except the driving force amplitude, gamma, 3 values of interest were chosen, .4 when the system was not chaotic, .45 when it was almost nearly chaotic and .47 when it was in full chaos. Time evolution of position, state-space plots, Poincare sections and a bifurcation diagram were chosen as evidence of non choatic vs chaotic character.

Introduction

We will fix all the following parameters as such:
alpha = 1.0
omega0 = 1.5π
omega = 2π
beta = 1.0

Where alpha is fixed constant, omega0 is the natural frequency, omega is the driving frequency, beta is the damping force.

Gamma (driving force amplitude) will be adjusted to .4, .45 and .47 for the graphs.

Bifucation

The following bifurcation diagram shows where the system is periodic and where it is choatic.

Time Evolution

As you can see the first 2 have periodic motion and the last one has choatic motion

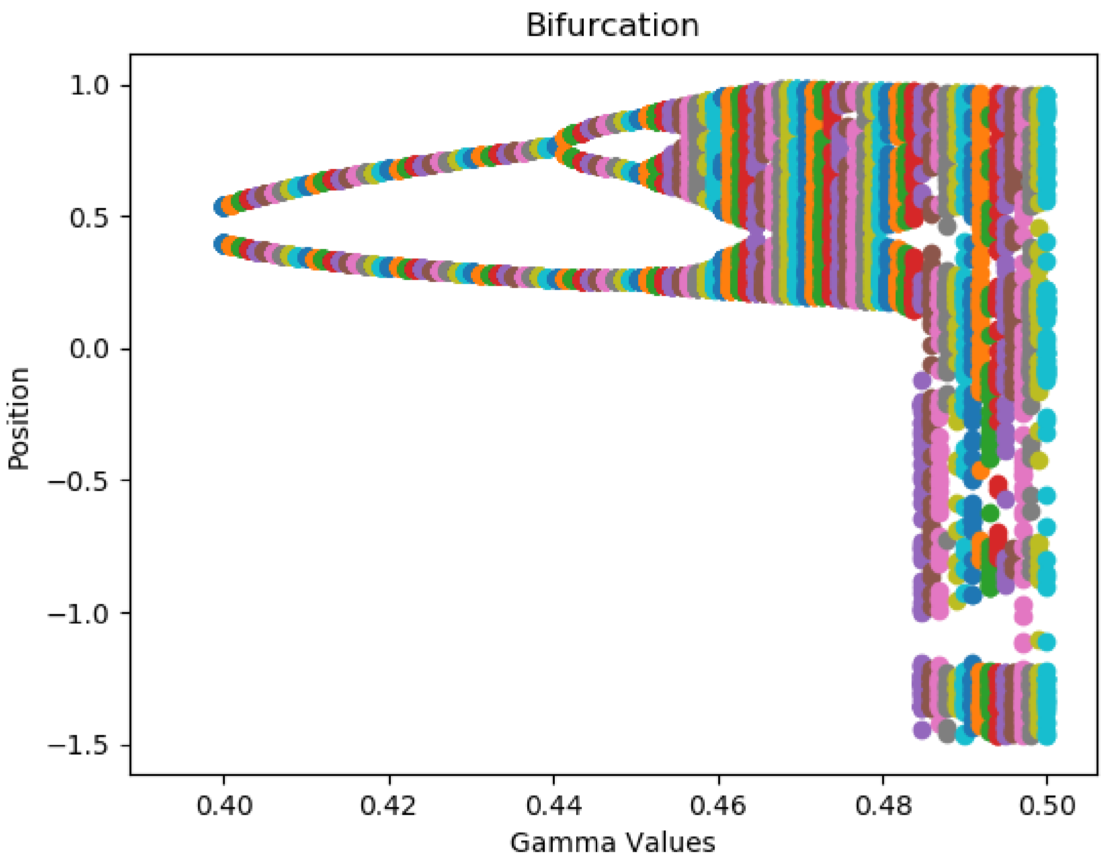

Figure 1: This bifurcation diagram from .4 to .5 with a 100 iterations between them shows that the system is non-choatic from .40 to about .445 and then is subsequently chaotic for the rest of the interval up until .5

State Plots

As you can see the first two are not chaotic systems and the last one is a chaotic system.

Poincaré Sections

As you can see the first one is double the period and the second quadruple periodicity and the last one is chaotic.

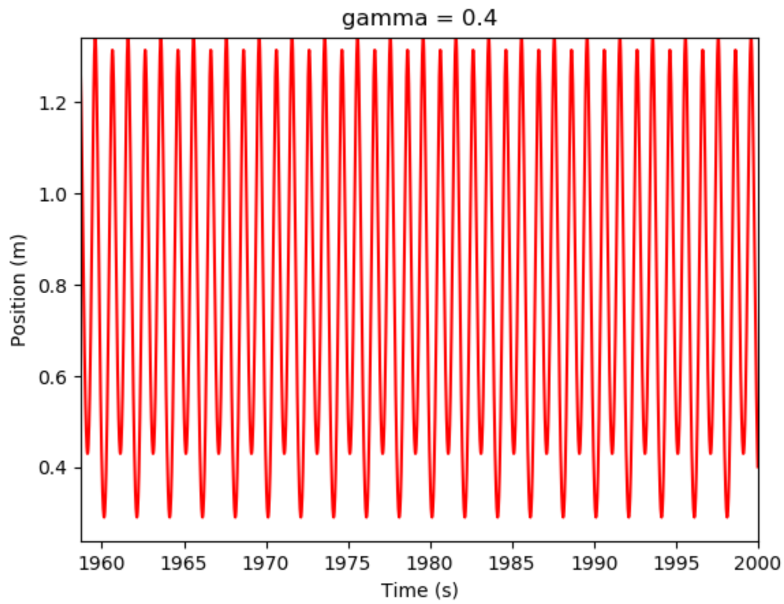

Figure 2: Peroidic Motion

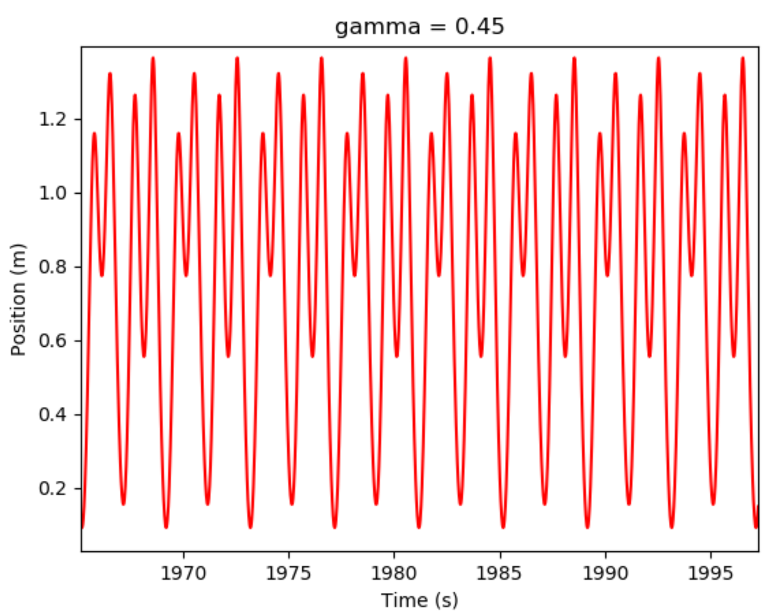

Figure 3: Periodic motion

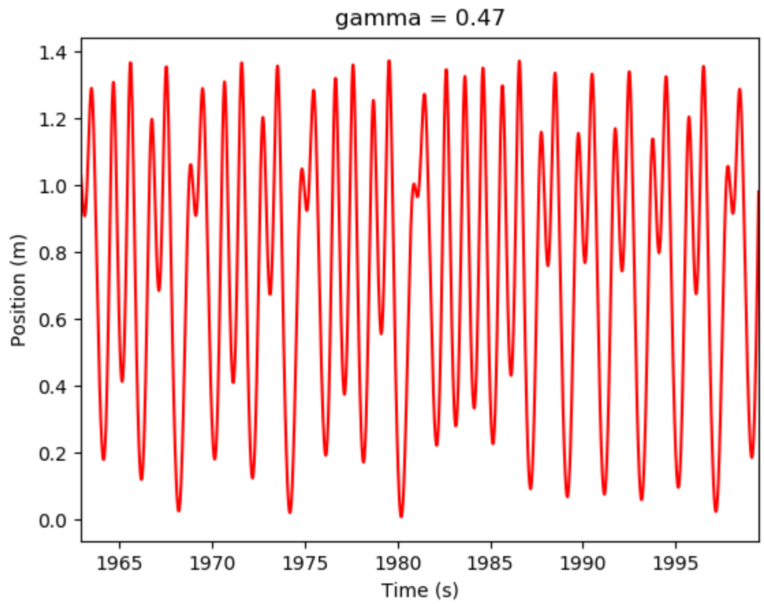

Figure 4: Aperiodic Motion

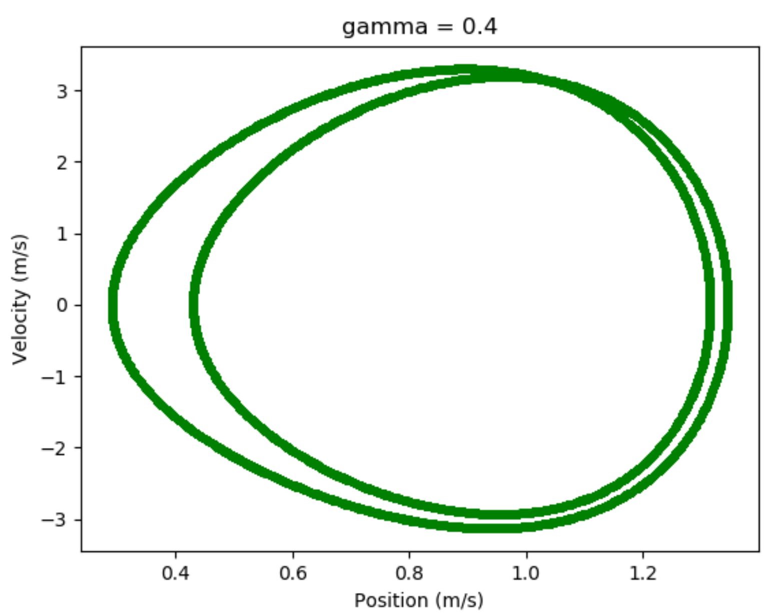

Figure 5: Periodic

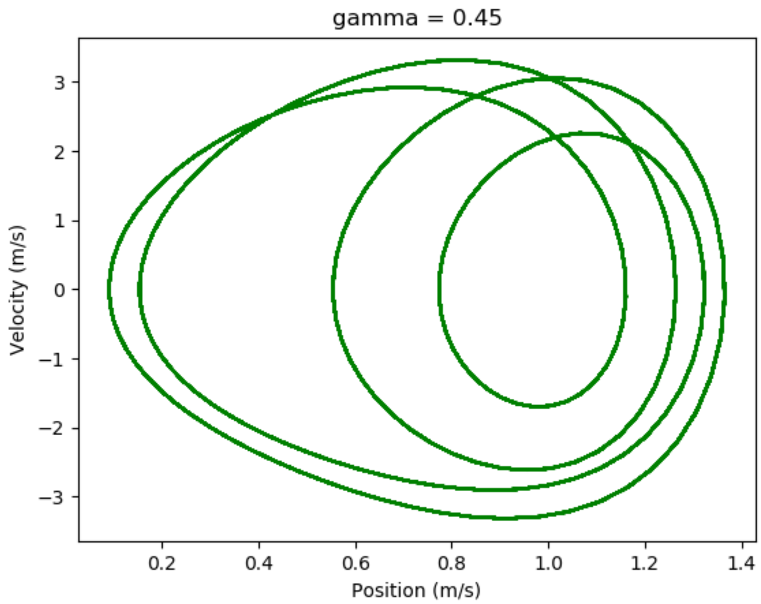

Figure 6: Also Periodic

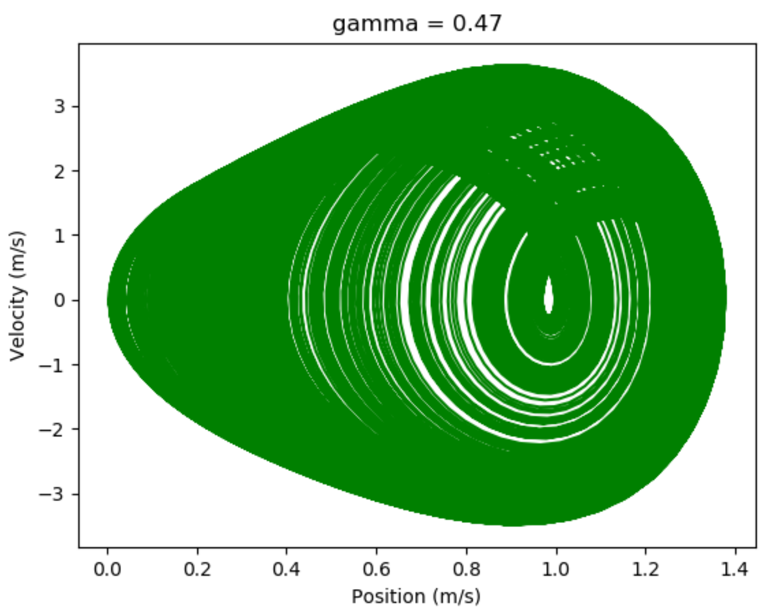

Figure 7: Aperiodic Motion closing in on an equilibrium solution

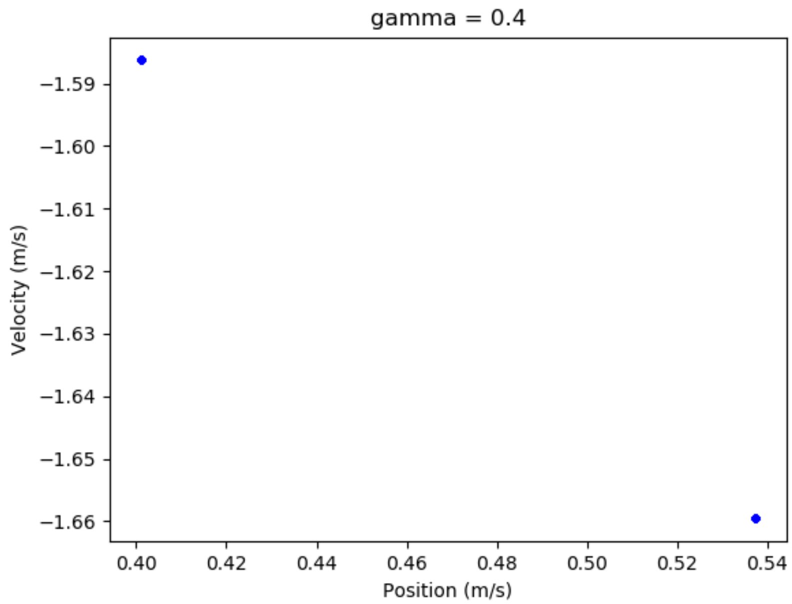

Figure 8: Period Doubling

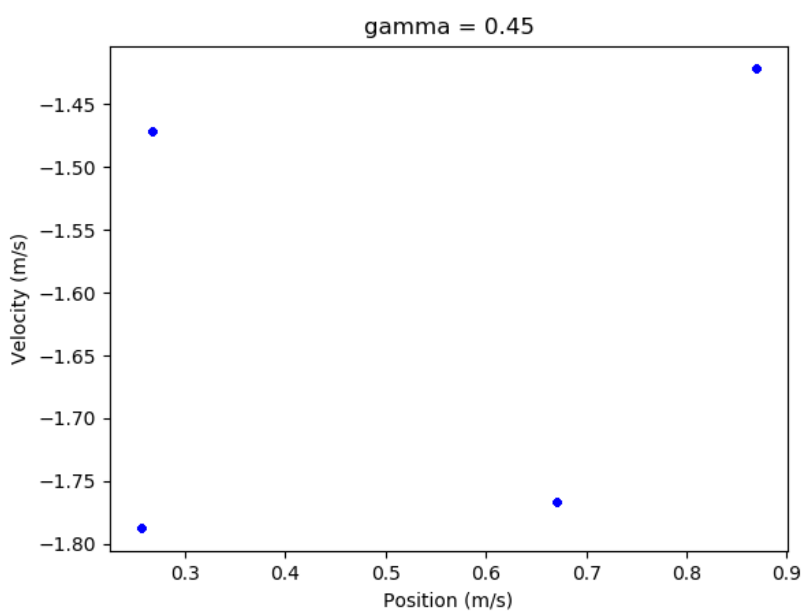

Figure 9: Period Quadrupling

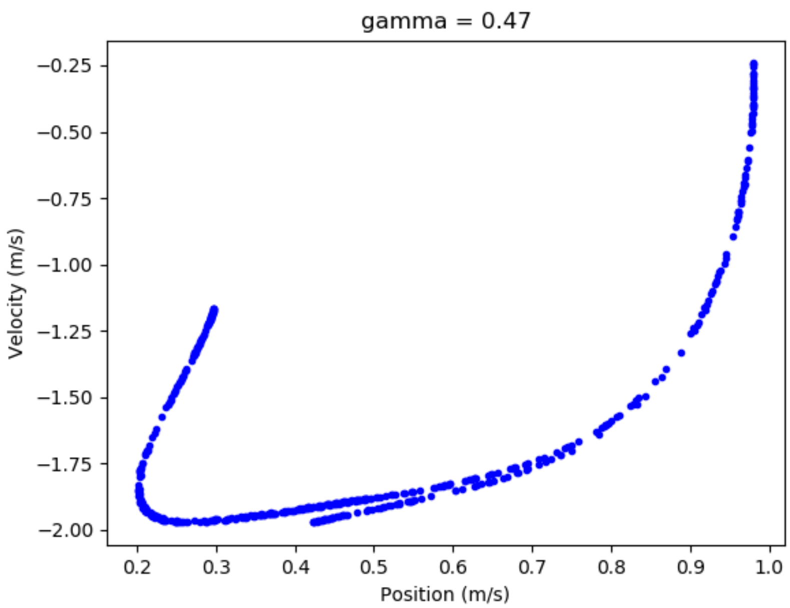

Figure 10: Period %#&$ing - (it's chaotic)