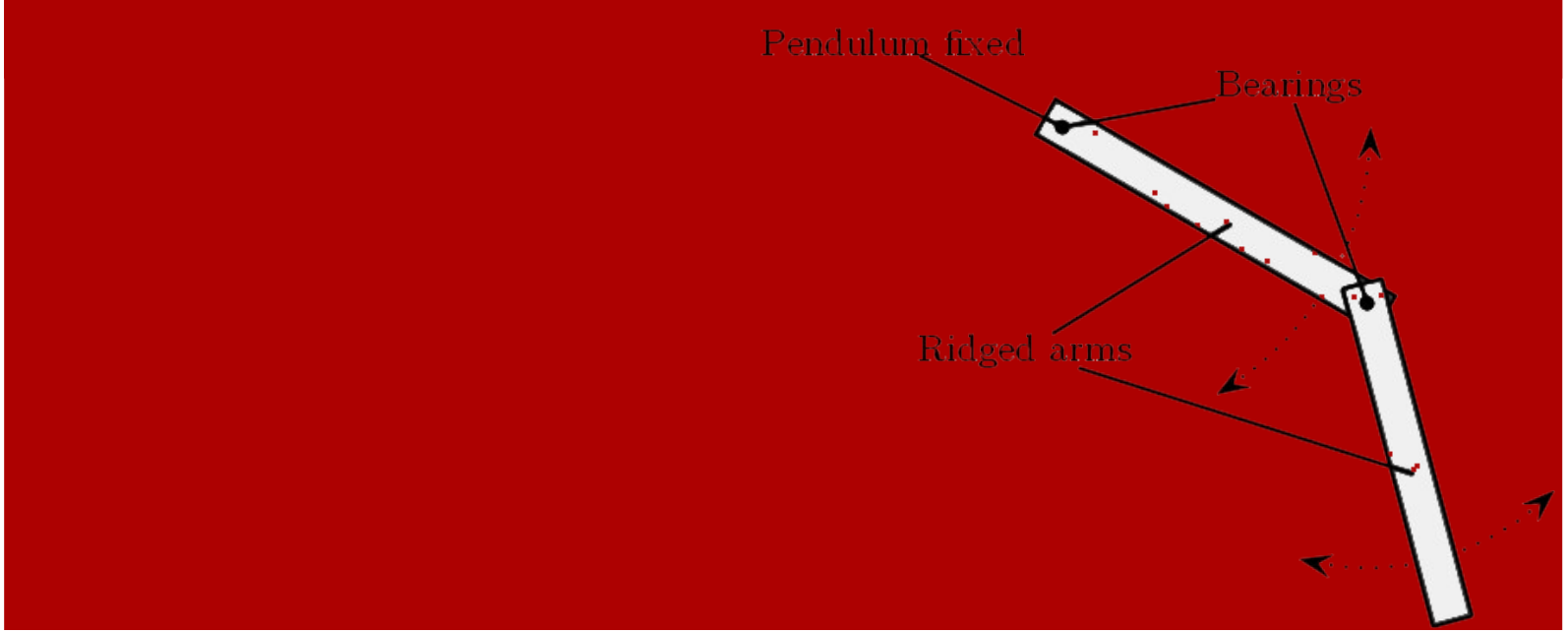
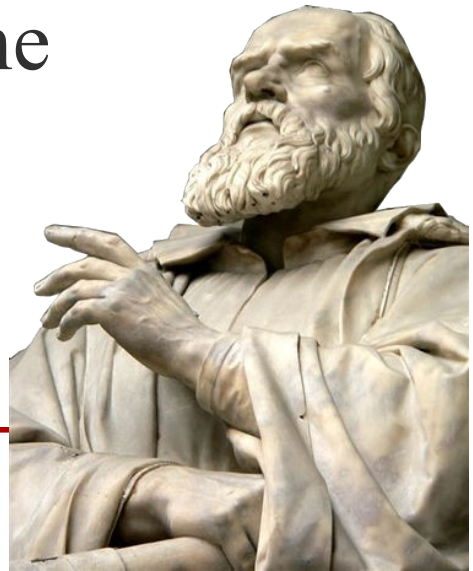


Double Pendulum

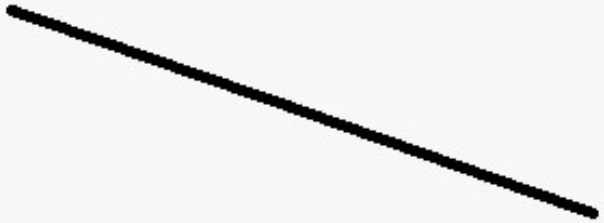
Ricardo Angeli Ethan DeJongh Josh Kilmer
Ryan Guinn Bob Ren

Motion of a Pendulum

- Normal pendulums are easy to predict, they follow very simple and predictable patterns.
- The first person to study the motion of a pendulum was Galileo in the 1500's.
- He discovered that the motion relied solely on the length and not the mass of the pendulum.



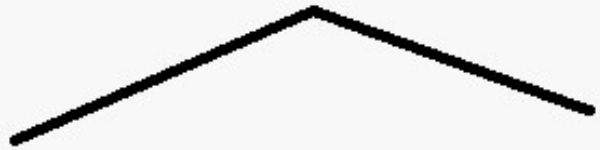
Motion of a Pendulum



Motion of a Double Pendulum

- A double pendulum is a pendulum with a second pendulum attached to the end of the first.
- Double pendulums are virtually impossible to predict.
- This is because the bottom pendulum affects the motion of the top pendulum and vice versa.
- A double pendulum is a classic real-life example of chaos theory due to its behavior.

Motion of a Double Pendulum

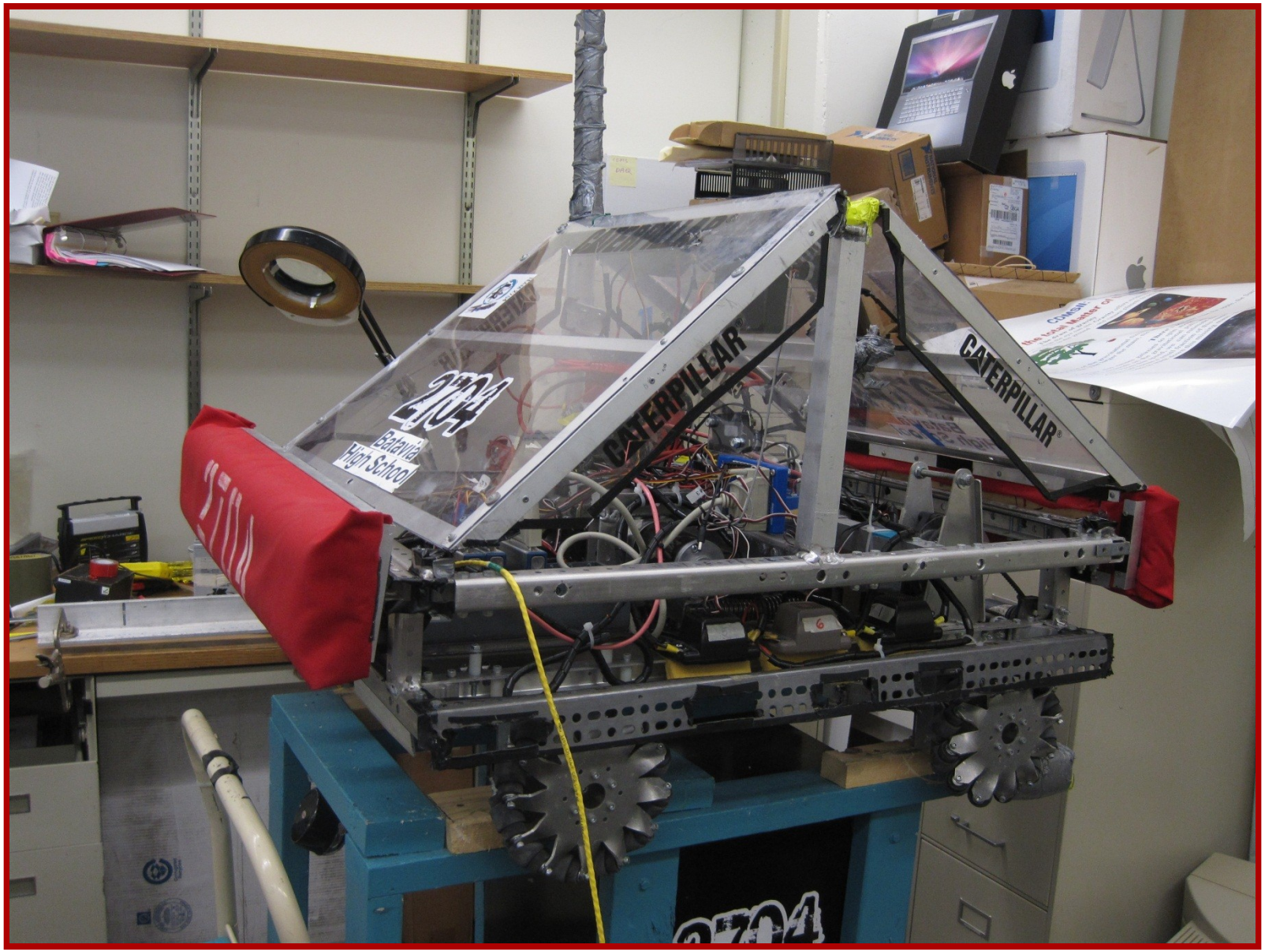


The Project

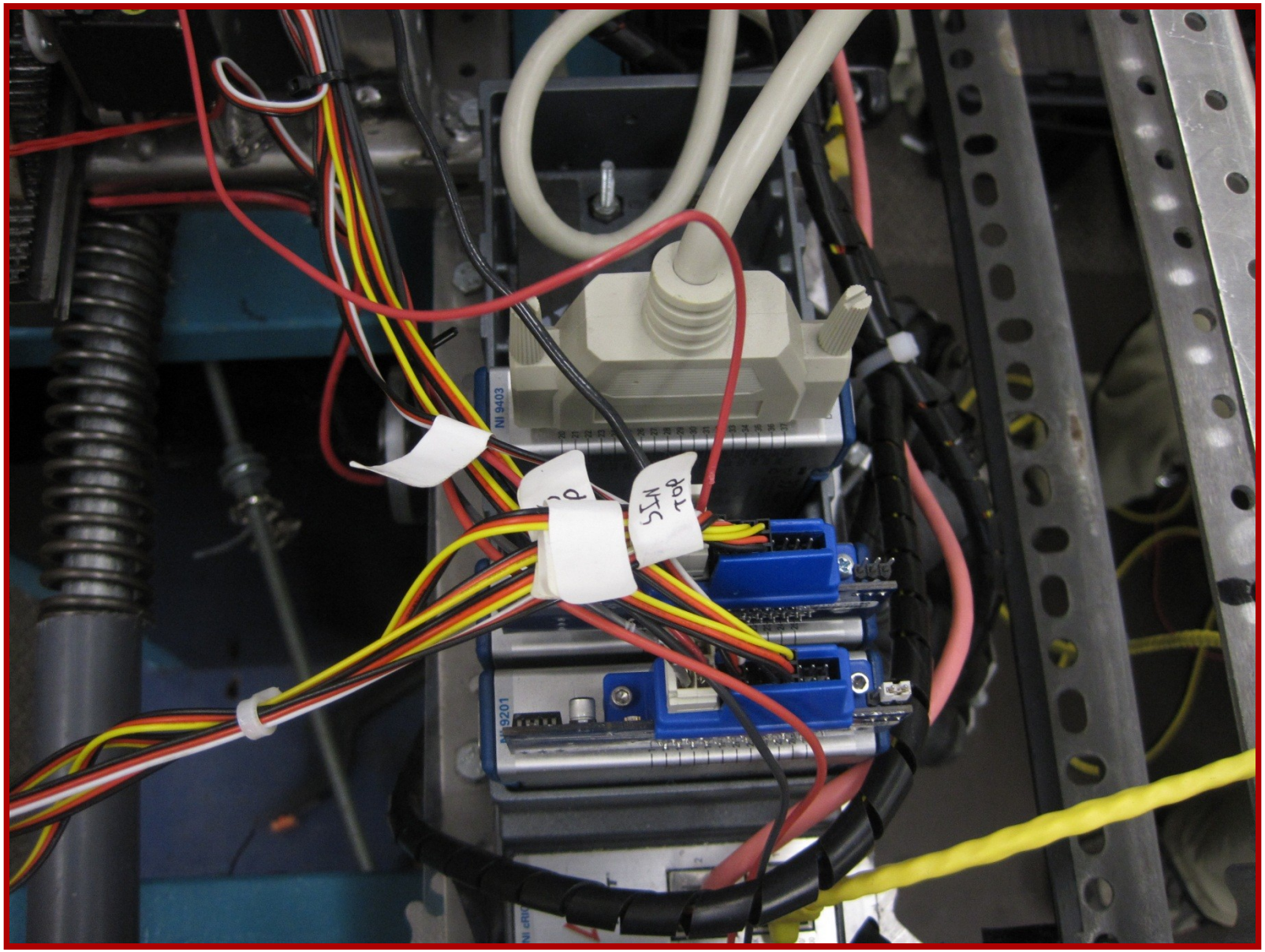
- The aim of the project is to analyze the behavior of a double pendulum.
- For this, we have constructed a double pendulum with magnetic encoders on each axles to read out the angles.
- With these angles, we can feed the motion of the pendulum into our program and gather data.

The Double Pendulum

The Data Acquisition System (Bröski)



The CompactRIO Chassis



Motion of a Double Pendulum

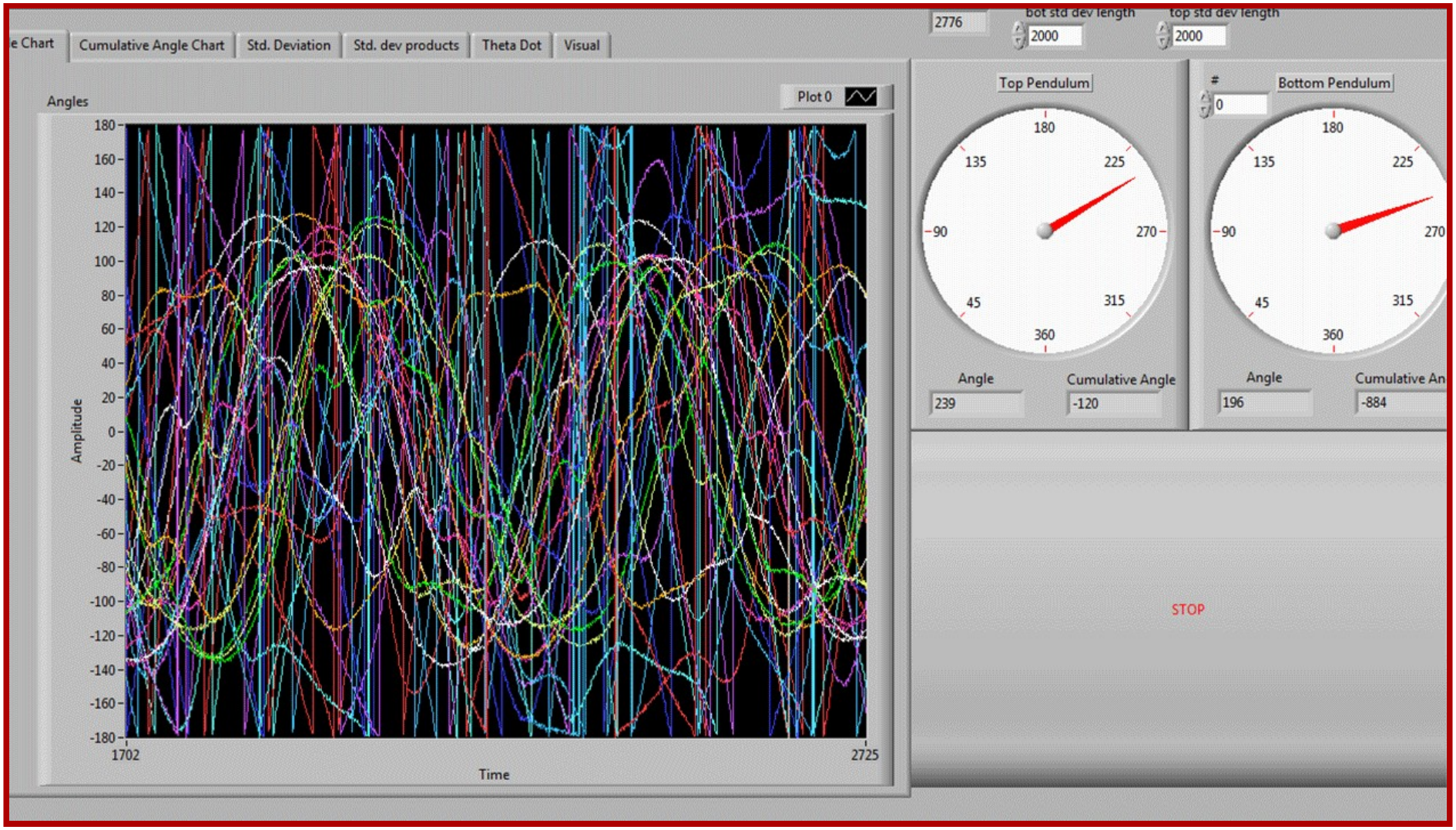
The Program

- Our double pendulum computer program sports a wide array of features.
- We begin by recording pendulum runs, meaning we swing the pendulum for a certain number of trials and the recording program writes the angles in a file.
- We can play back these files in our playback program.

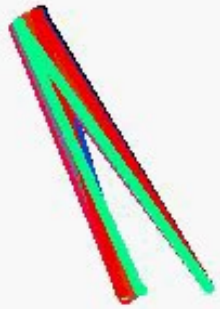
The Program

- The playback program supports playing a virtually infinite amount of runs at the same time for easy analysis.
- It generates over 15 different graphs displaying different sets of data.
- Here are some of the more interesting ones:

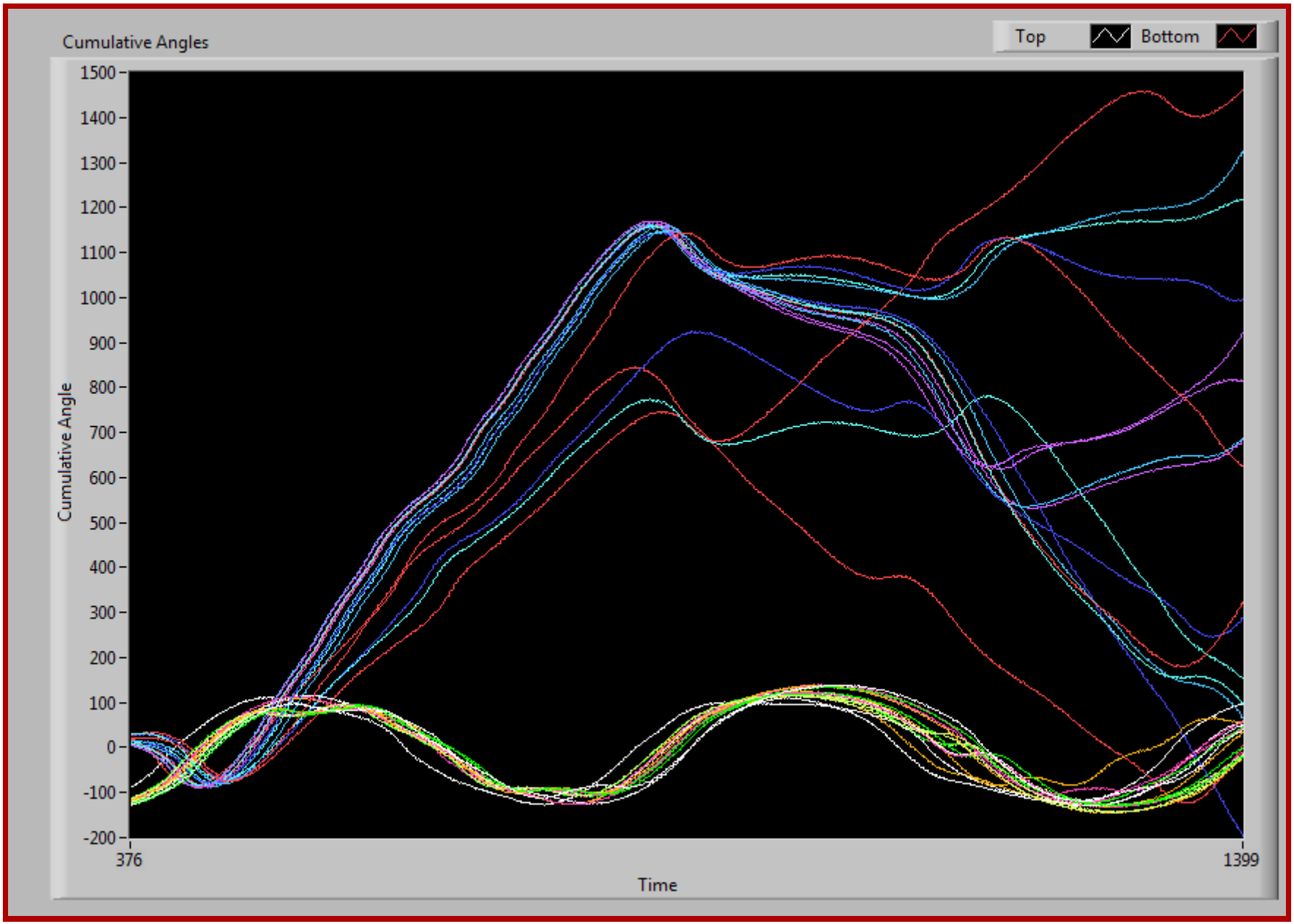
The Program's Front Panel



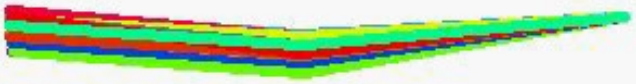
The Unpredictable Run



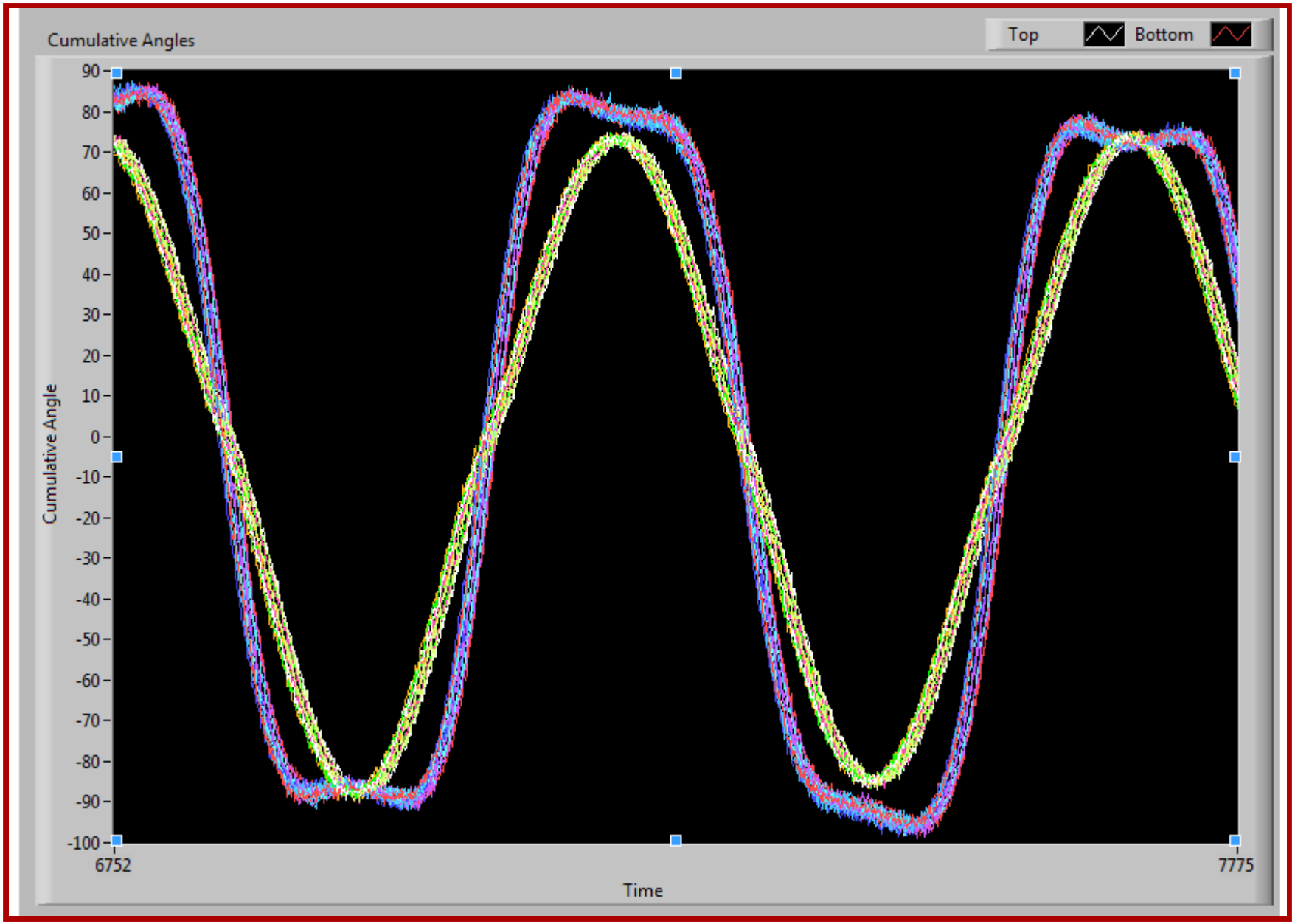
Cumulative Angle Chart for the Unpredictable Run



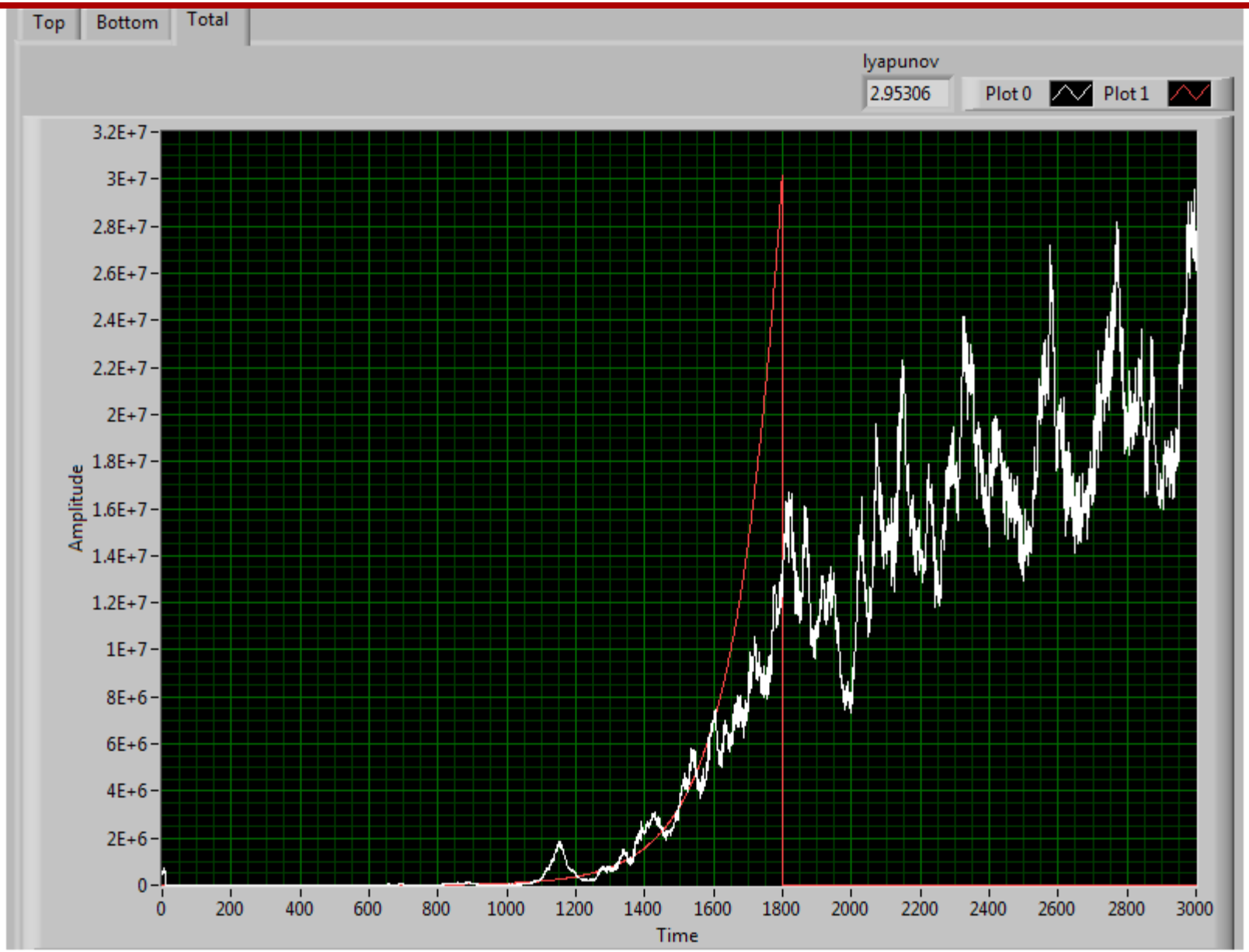
The Predictable Run



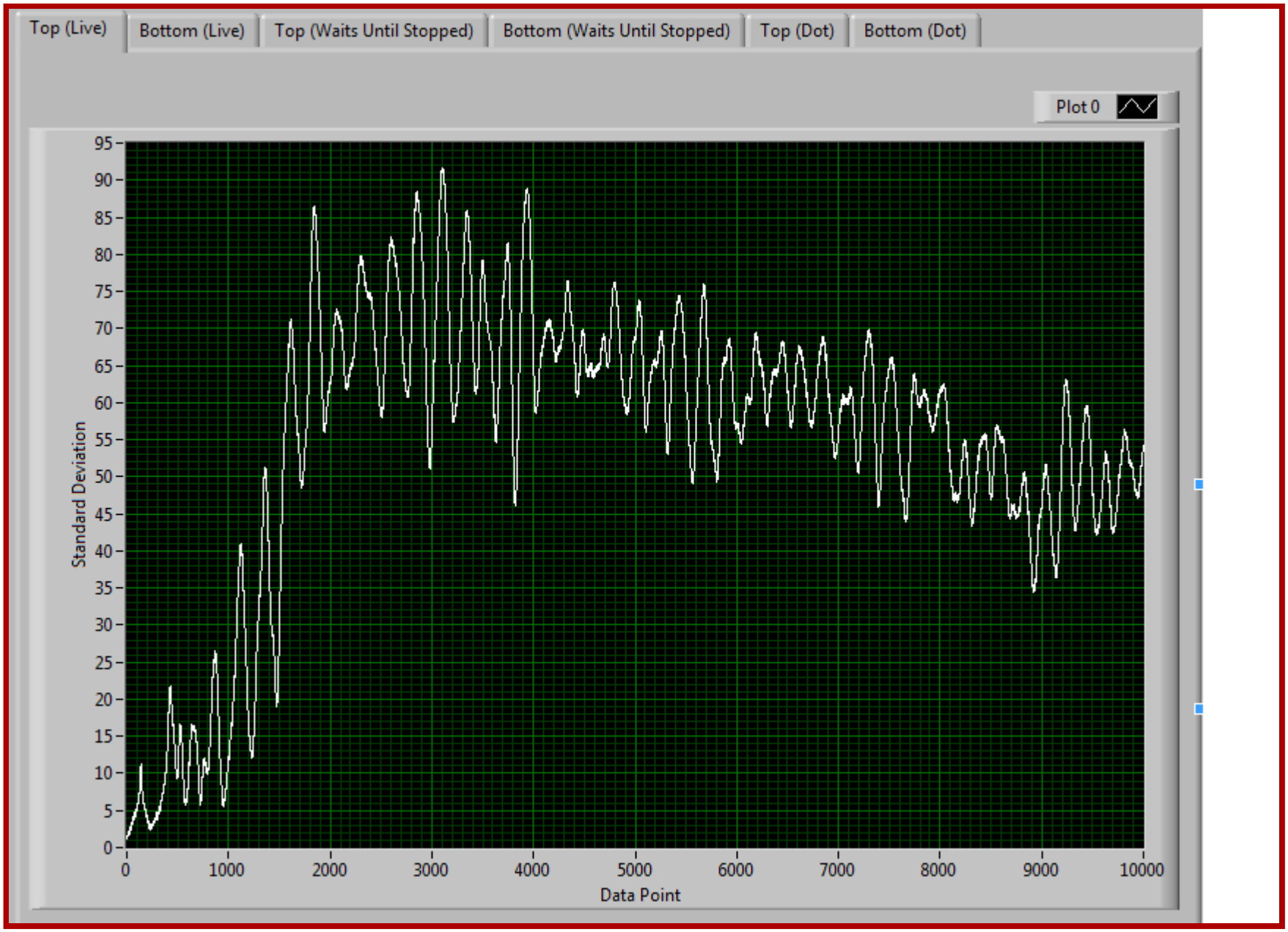
Cumulative Angle Chart for the Predictable Run



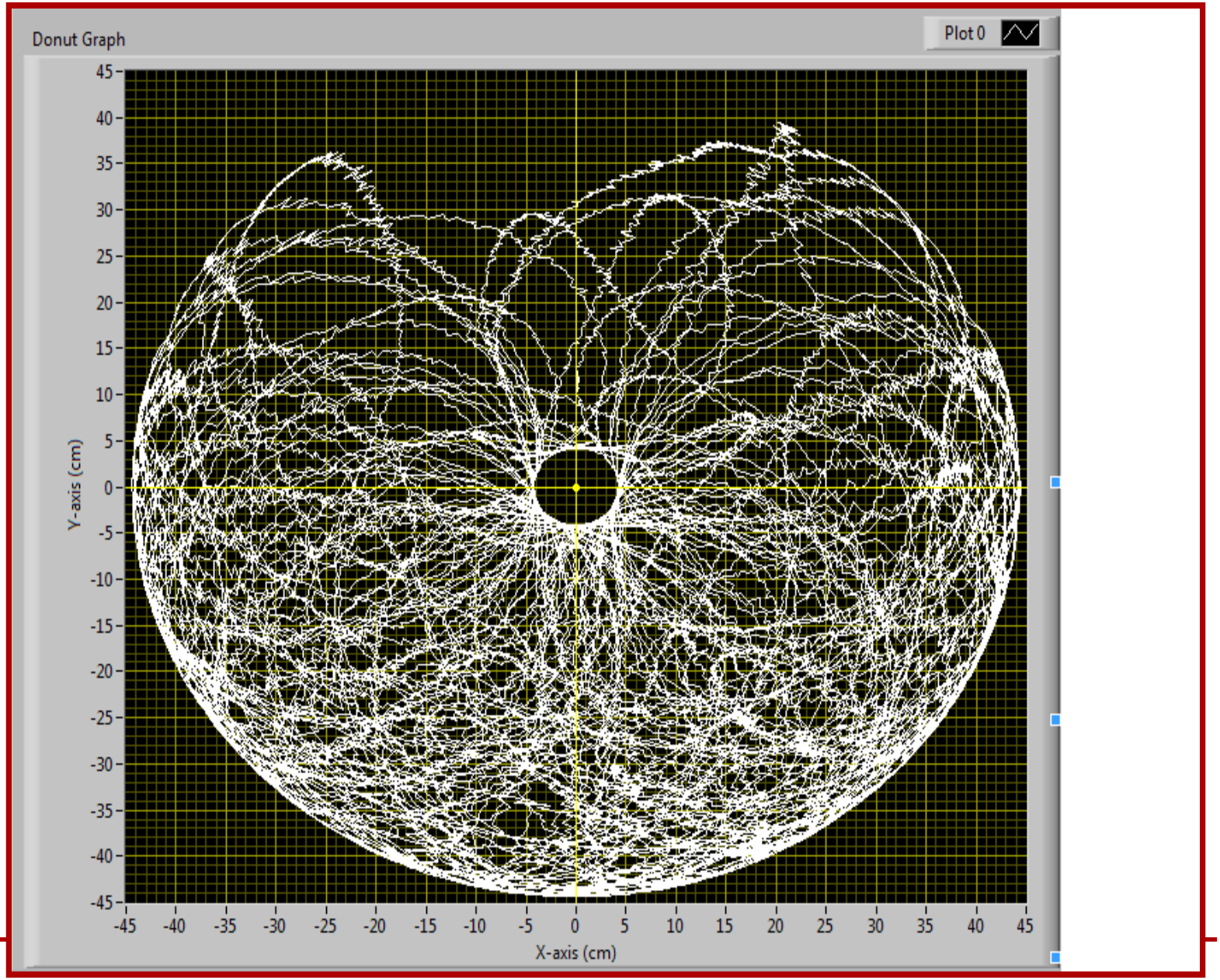
Exponential Fit for Product of Standard Deviation Graphs

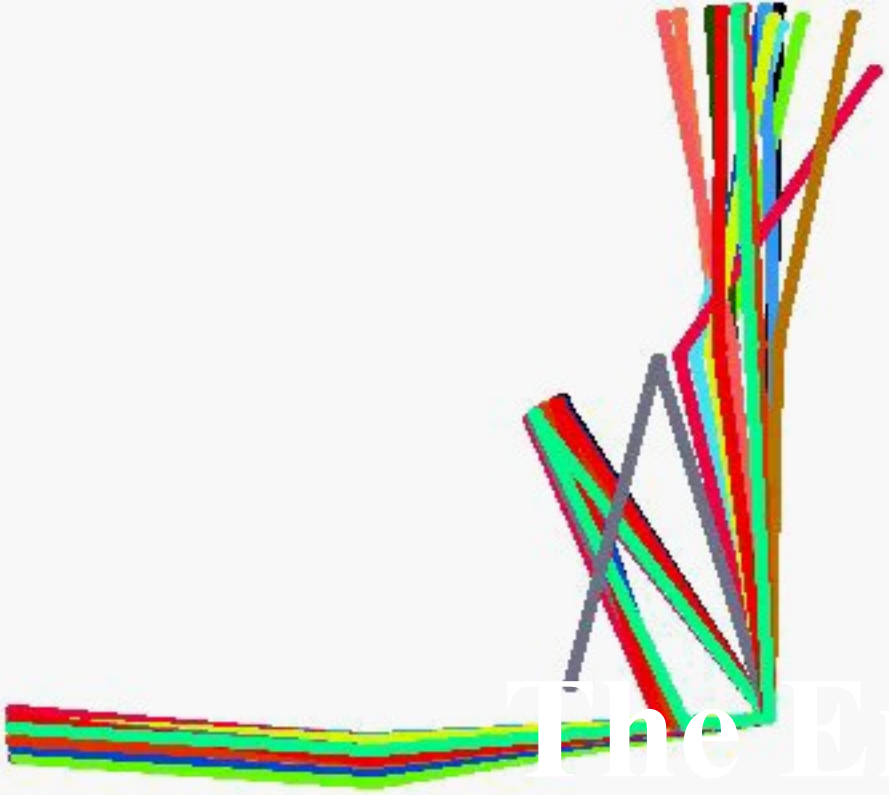


Top Standard Deviation



Donut Graph


Donut Graph
Plot 0
Y-axis (cm)
X-axis (cm)
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45


The End