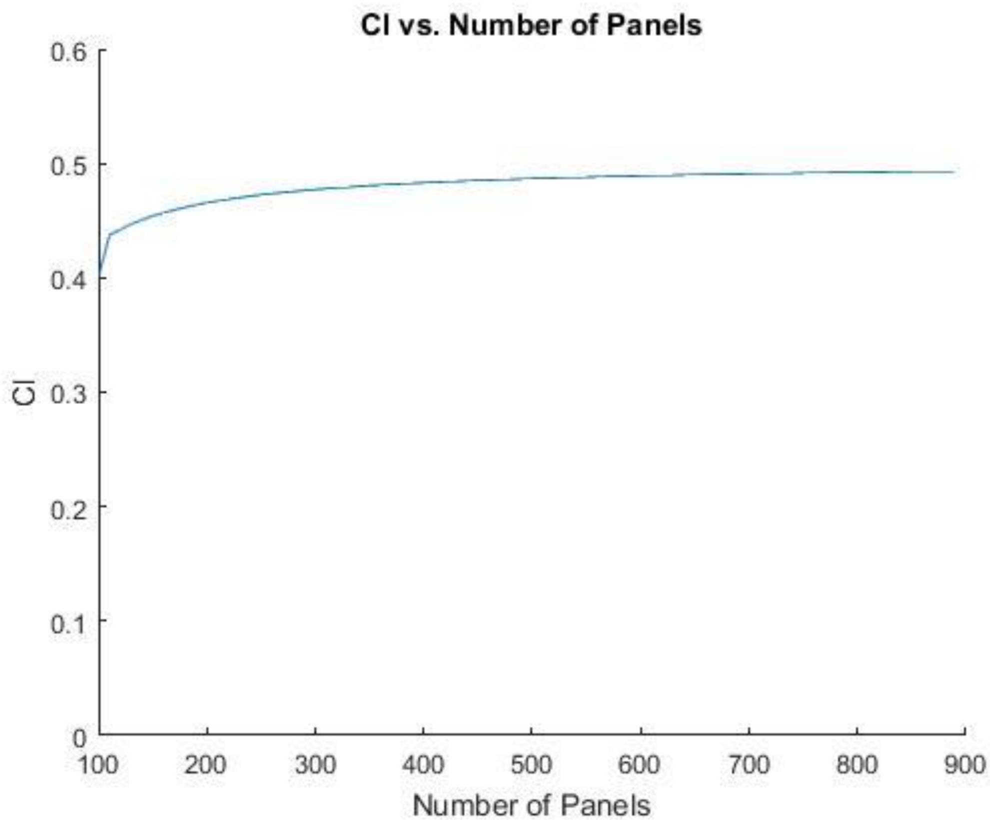
1) How many panels did your team choose and why?

The team chose to use 890 panels. A function was written to calculate the Cl at the steady state condition while increasing the number of panels. The function would stop once the Cl stopped changing within an inputted tolerance. The function was modified to only run if that tolerance and interval had been run previously.



As can be seen, the Cl increases and asymptotically approaches the true value. In this case, the team has chosen to have a tolerance of .0001 between adjacent Cl values, and increase the number of panels by 10 each time. Giving a total number of 890 panels.

2) Report how long it takes the code to produce the final result

Using K = 0.1, with 101 time steps, the code takes 52.81 seconds to run.

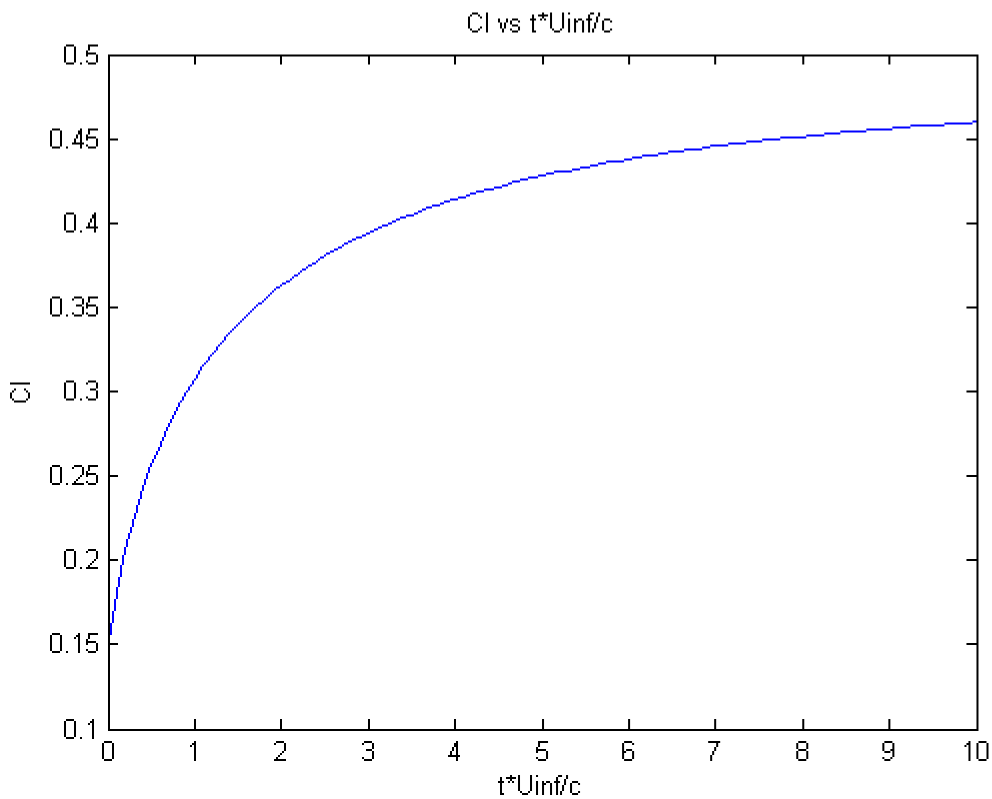
3) Briefly discuss the differences between the K = 0.1 case and the K = 0.4 case.

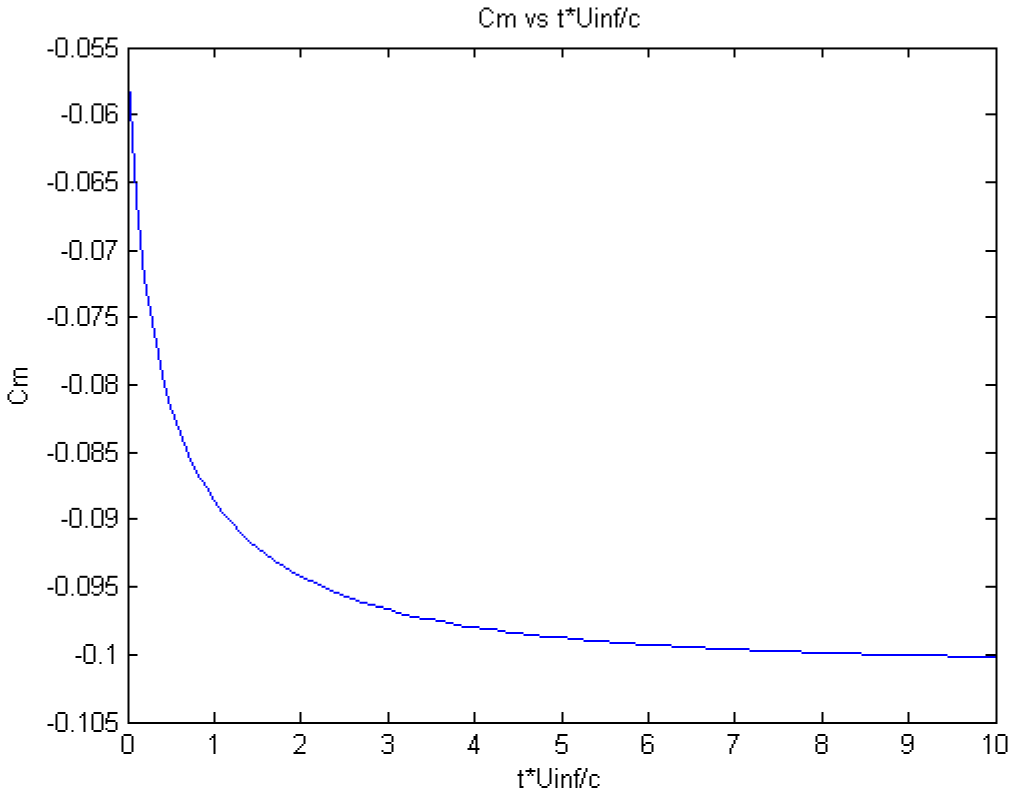
K = 0.4 uses only 26 time steps to reach a time of 2 seconds. With K = 0.4, the Cl concludes at 0.4634, while for K = 0.1, it reaches 0.4599. With K = 0.4, the Cm finishes at -0.1004, while in the K = 0.1 case, the Cm finishes at -0.1002. In the K = 0.1 case, the wake vortices appear closer together than the K = 0.4 case. This is logical, as the time between their shedding is lower in the K = 0.1 case.

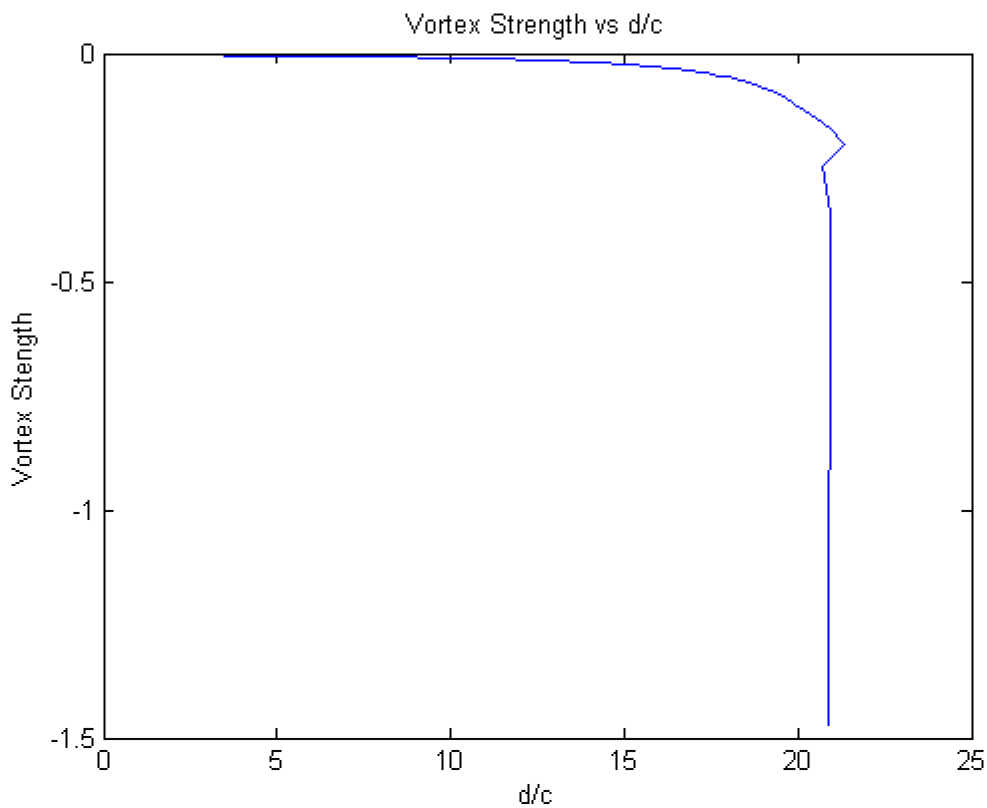
4) State what your team believed would happen for the K = 0.01 case. Discuss what the actual result was. Give a well reasoned argument (based on your knowledge of potential flows, point vortices, etc.) explaining the actual result.

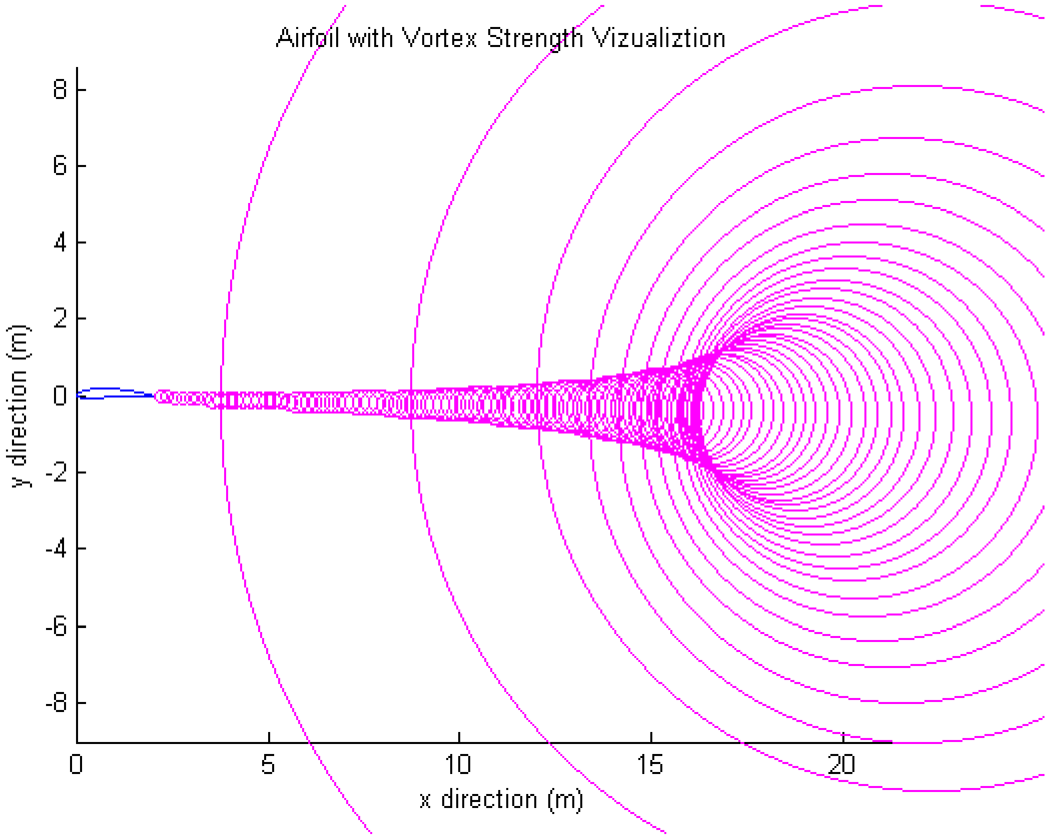
The team believes based on what happened between K = 0.4 and K = 0.1, the values for Cl and Cm will decrease slightly approaching the correct values. On the graph, the vortices will be very close together. The team also predicts a very long runtime for the smaller time step.

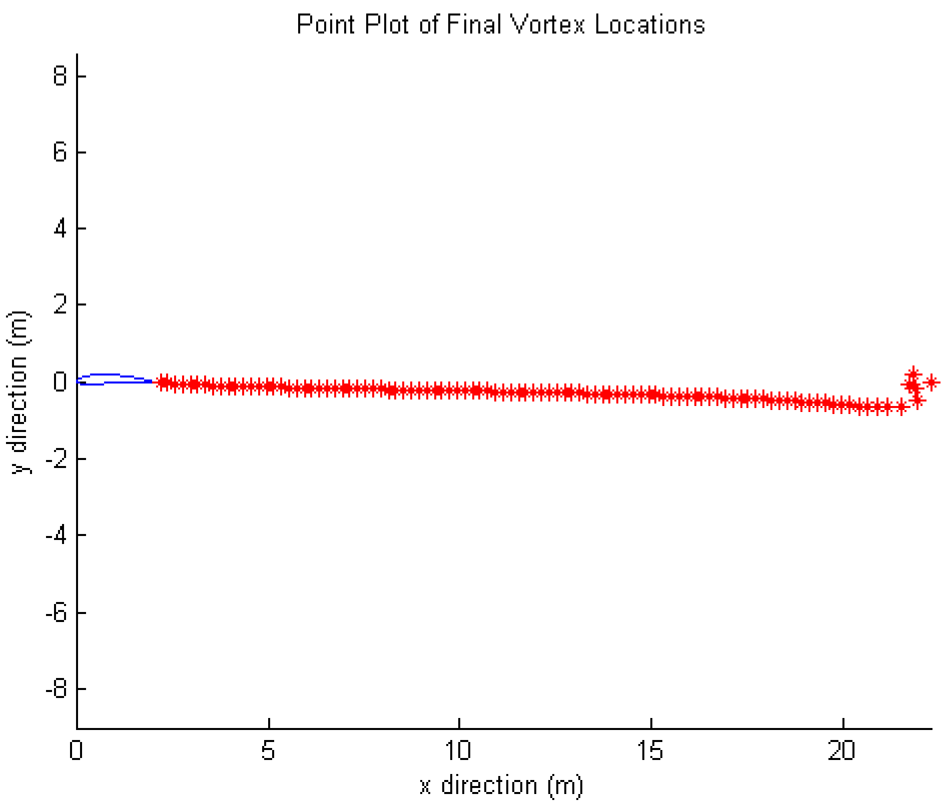
One unexpected event was that as the number of time steps increases, the time each step takes to run increases, causing it to take 28 minutes to run to completion. This is logical because the velocity for each point is dependent on every other vortex. The Cl converges to 0.4495. The Cm converges to -0.0983. The point vortices don't even appear more than 2m out from the airfoil. We would guess that the cause of this is caused by each point being so small, that they do not appear on the graph.

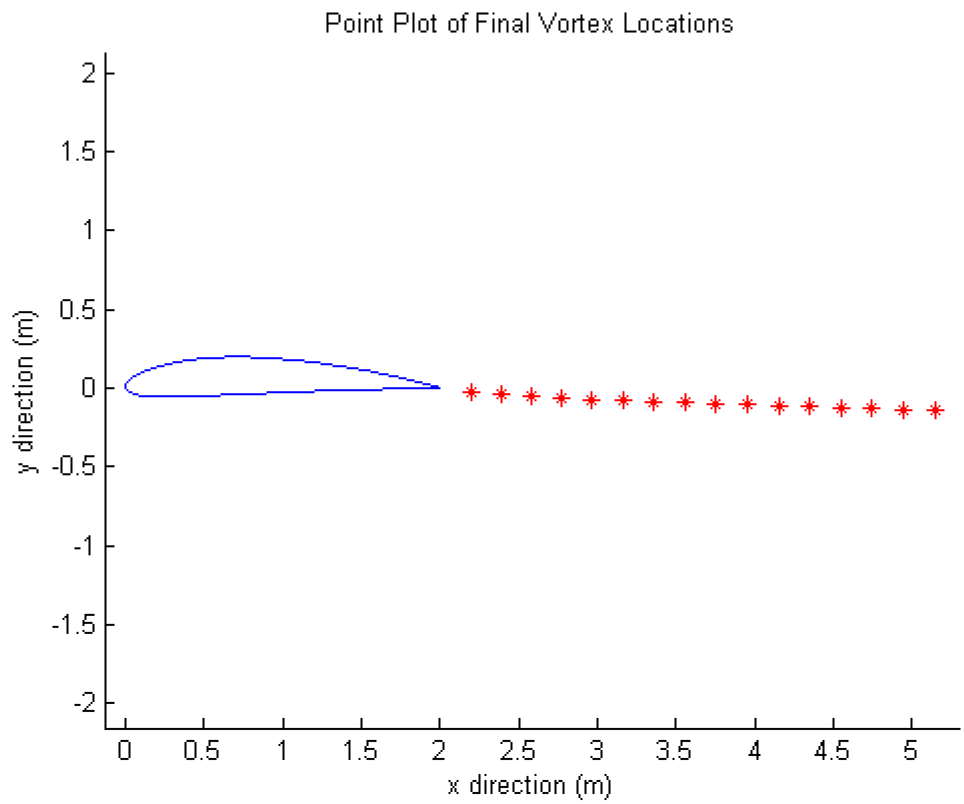



Cm vs t*Uinf/c
Cm
t*Uinf/c
-0.055
-0.06
-0.065
-0.07
-0.075
-0.08
-0.085
-0.09
-0.095
-0.1
-0.105
0
1
2
3
4
5
6
7
8
9
10

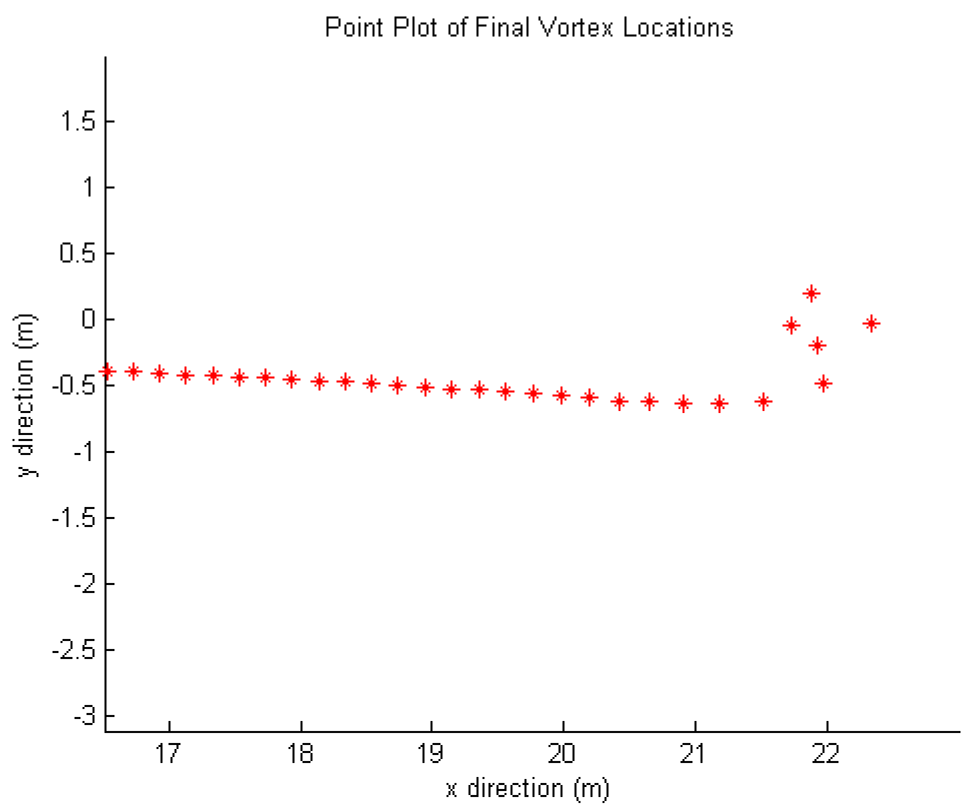

Vortex Strength vs d/c
Vortex Stength
d/c
0
-0.5
-1
-1.5
0
5
10
15
20
25


Airfoil with Vortex Strength Vizualiztion
y direction (m)
x direction (m)
8
6
4
2
0
-2
-4
-6
-8
0
5
10
15
20

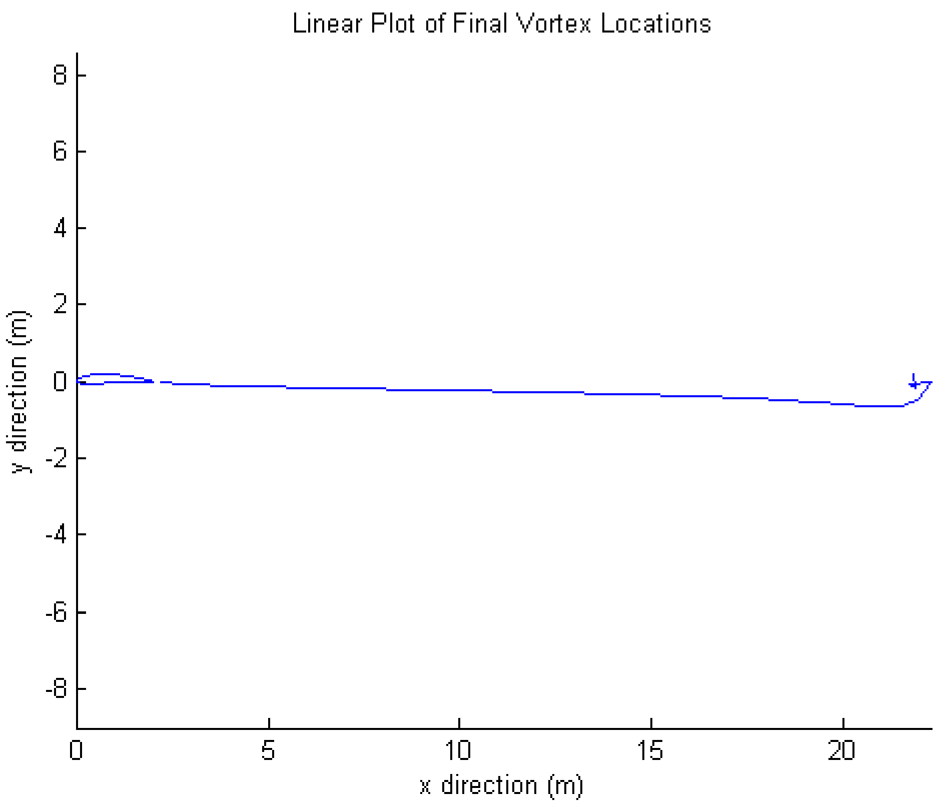

Point Plot of Final Vortex Locations
y direction (m)
x direction (m)
8
6
4
2
0
-2
-4
-6
-8
0
5
10
15
20



Point Plot of Final Vortex Locations
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
y direction (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
x direction (m)



Point Plot of Final Vortex Locations
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
y direction (m)
17
18
19
20
21
22
x direction (m)



Linear Plot of Final Vortex Locations
8
6
4
2
0
-2
-4
-6
-8
y direction (m)
0
5
10
15
20
x direction (m)