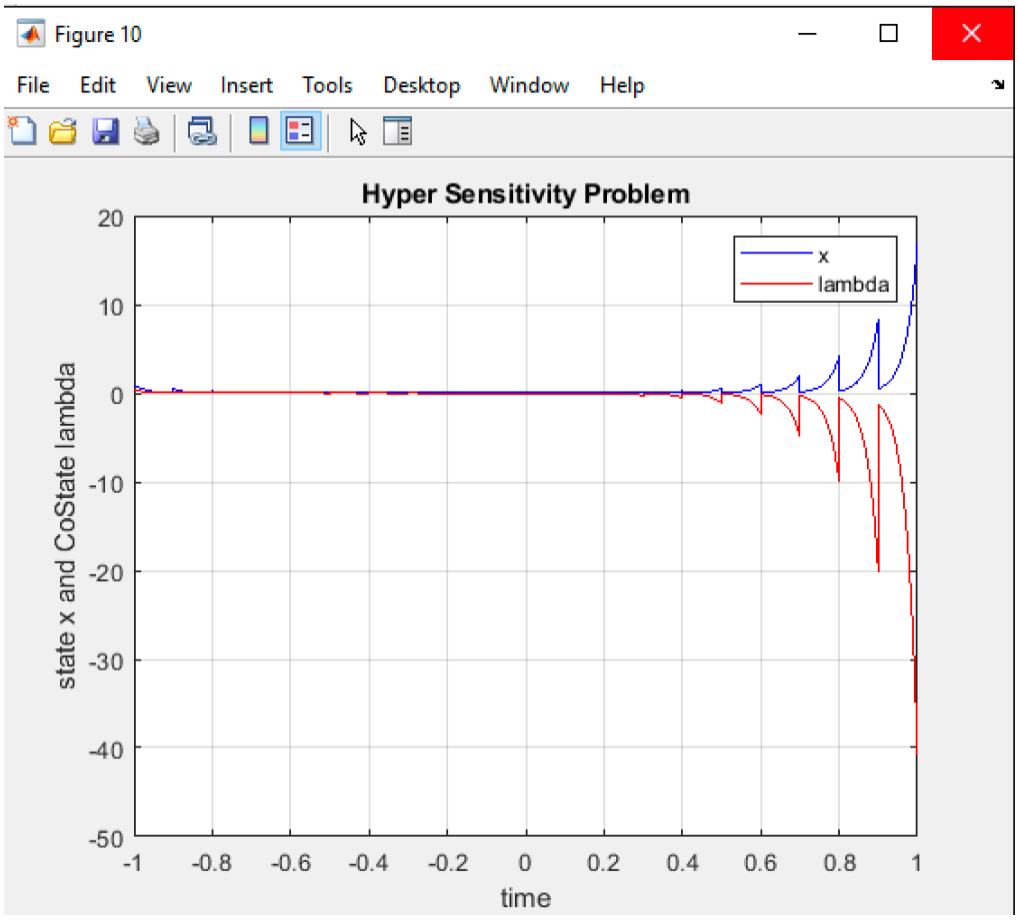
Problem #1: Hyper-Sensitive Optimal Control Problem

Simulation Results-

For K=20 intervals



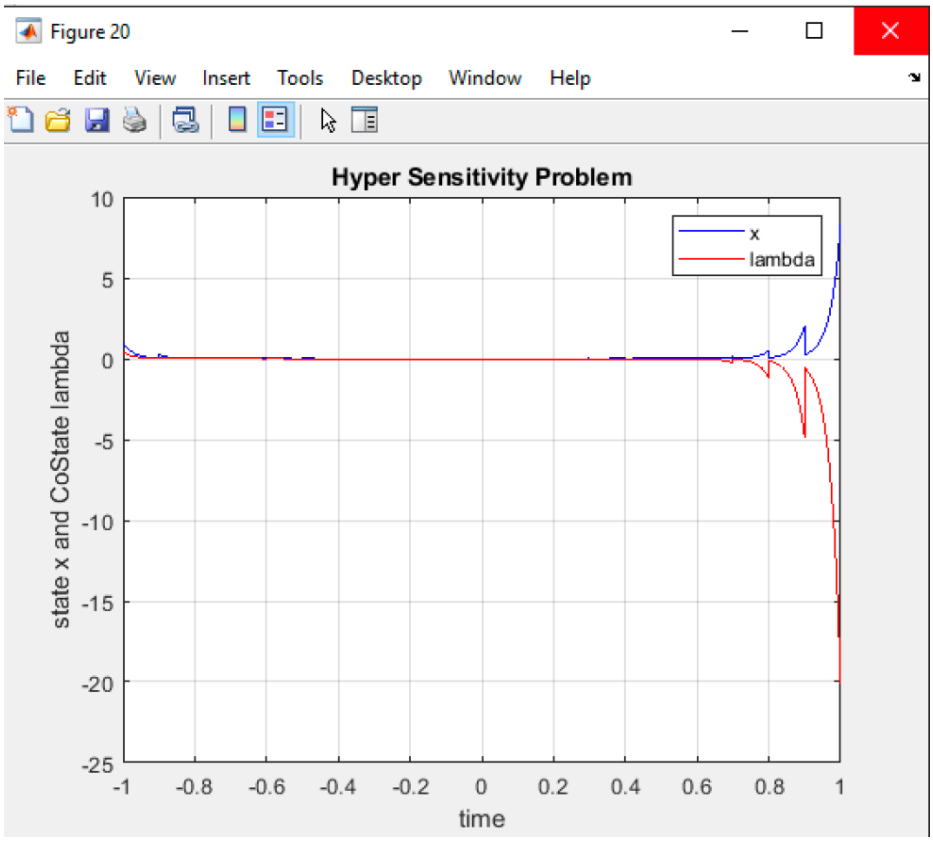


Figure 20
File Edit View Insert Tools Desktop Window Help
Hyper Sensitivity Problem
x
lambda
state x and CoState lambda
time
10
5
0
-5
-10
-15
-20
-25
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

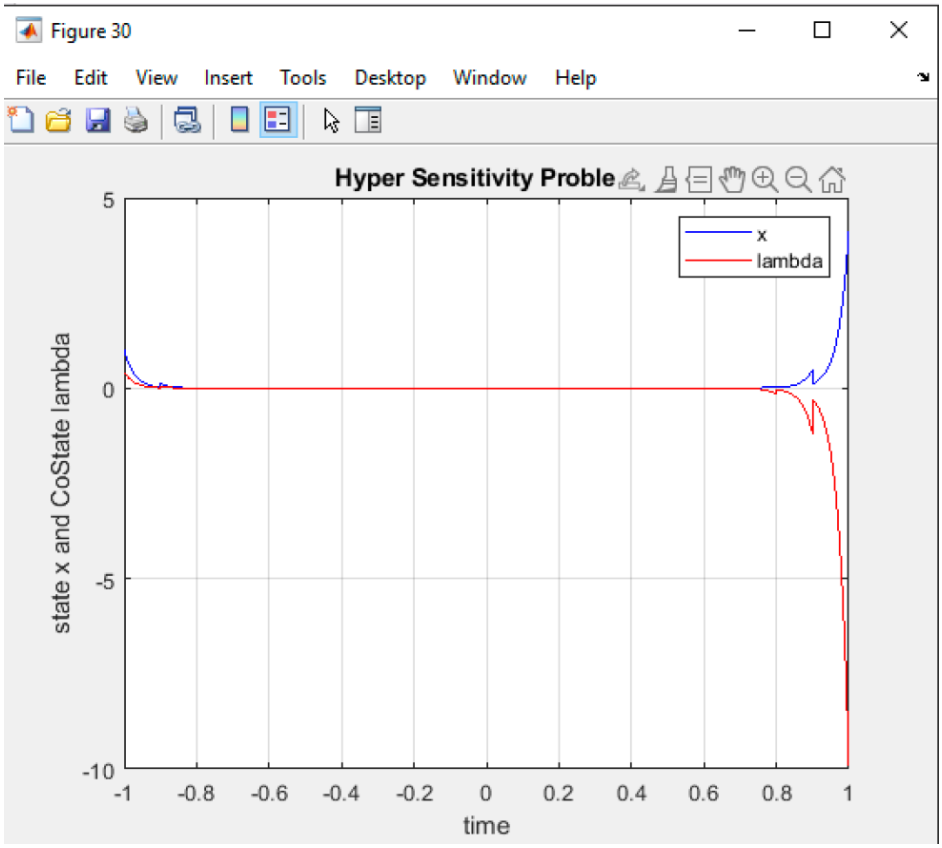


Figure 30
File Edit View Insert Tools Desktop Window Help
Hyper Sensitivity Proble
x
lambda
state x and CoState lambda
time
5
0
-5
-10
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

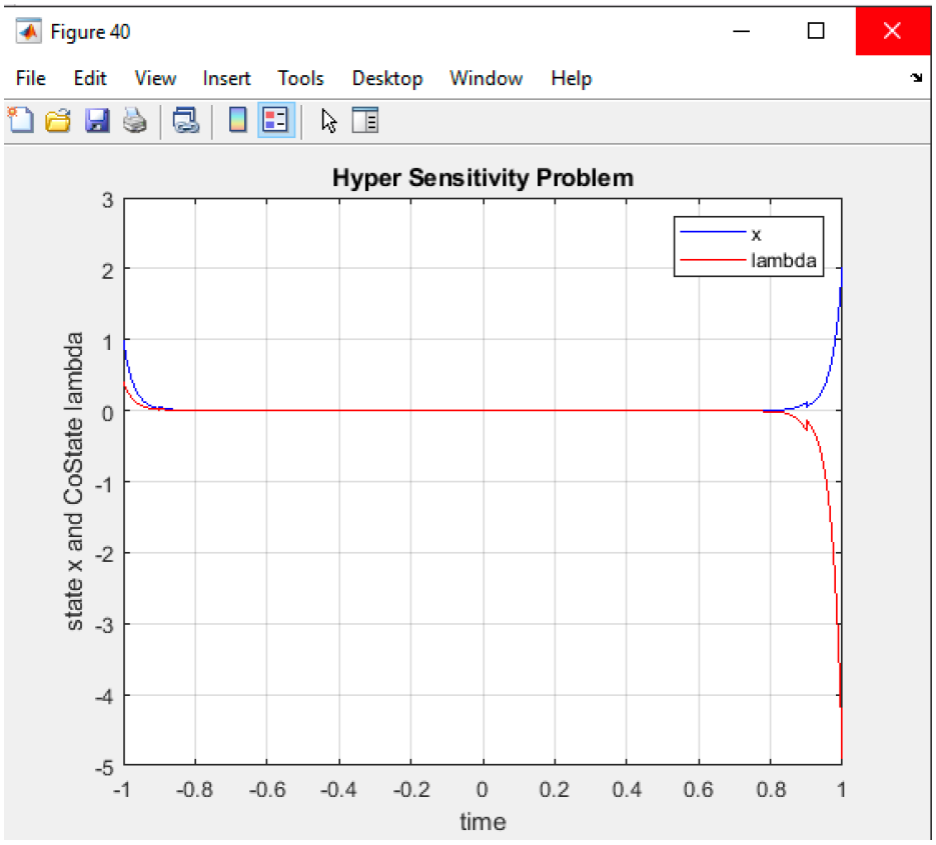


Figure 40
File Edit View Insert Tools Desktop Window Help
Hyper Sensitivity Problem
x
lambda
state x and CoState lambda
time
3
2
1
0
-1
-2
-3
-4
-5
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

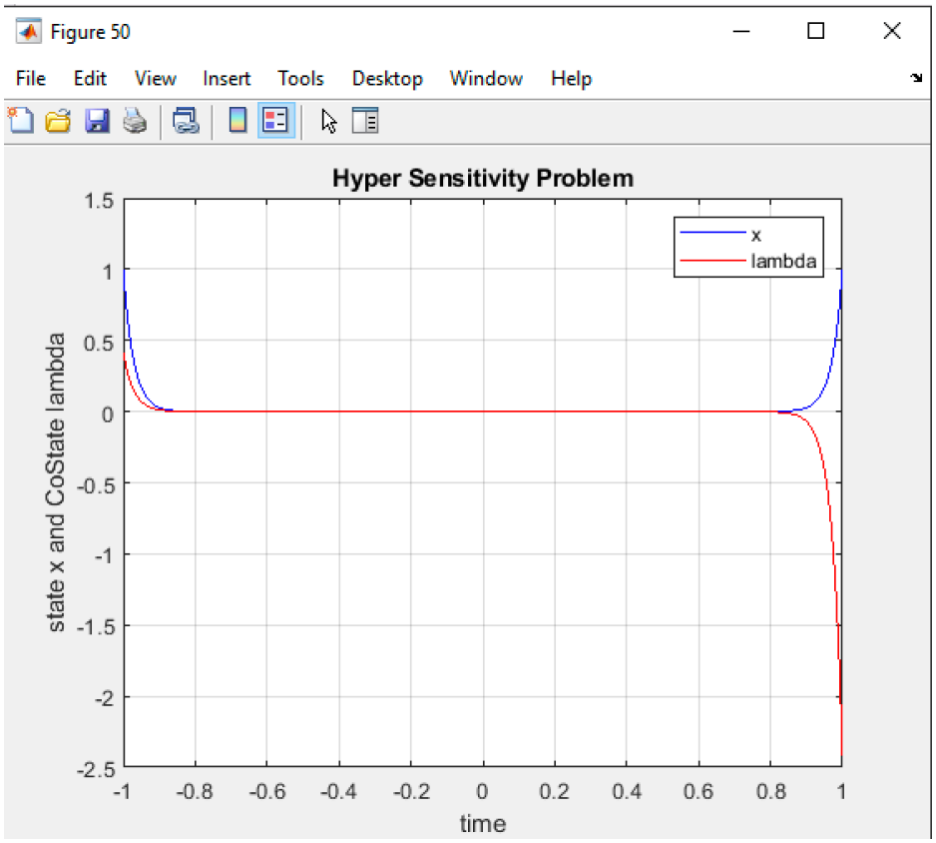


Figure 50
File Edit View Insert Tools Desktop Window Help
Hyper Sensitivity Problem
x
lambda
state x and CoState lambda
time
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

Conclusion-

As final time (t_f) increases the value of the state increases exponentially. As a result, the results are out of scope of the precision of the machine and can't not be computed.

As t_f increases the number of required intervals also increases to get a better estimate so the computer can calculate the roots without blowing up.

The multiple shooting method was able to compute results faster than the single shooting method. But I both single step shooting and multiple shooting method gave me the same lambda_0 value of 0.4142.