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Script for 2011 ME227 HW 4 Problem 2

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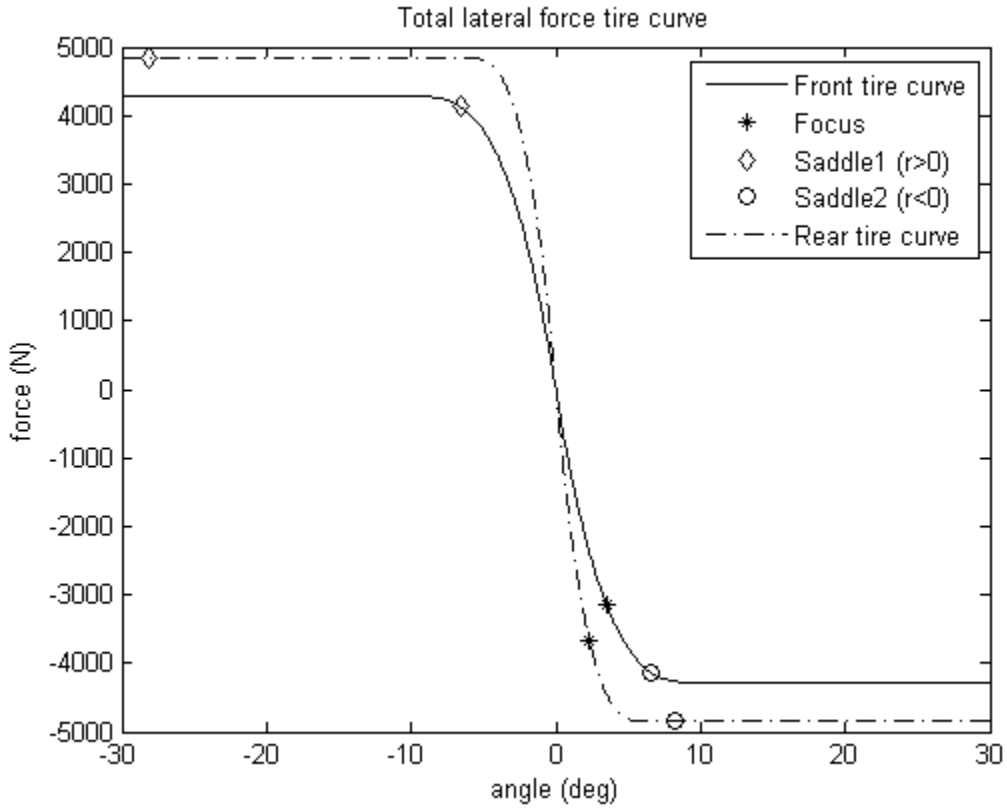
2(a) Tire curves: Fiala bike model

The results are below, given as [Focus Saddle1(r>0) Saddle2(r<0)]

The plots show that the stable focus has front and rear forces in the diretion of delta, which makes sense. We are also not in the saturated regions of the tire force curve. Saddle1 is clearly unstable - the rear tire is heavily saturated, so we are limit oversteer. Saddle2 looks OK in the front, but the rear tire is also saturated, leading to a limit oversteer, also unstable.

Saddle point 1 (r>0) corresponds to a left-hand drift. Our yaw rate is counterclockwise, and the rear tire is competely saturated, leading to severe slip, therefore "turning right to go left".

```
beta =

   -1.7368  -22.8130    2.8132

alpha_f =

    3.4850   -6.5294    6.5296

alpha_r =

    2.3336  -28.1658    8.1660
```



2(b) Effective cornering stiffness

See below.

```
C_af0 =
  1.0e+004 *
    3.1210    0.8353    0.8323

C_ar0 =
  1.0e+004 *
    5.2094         0         0
```

2(b) Local understeer gradient

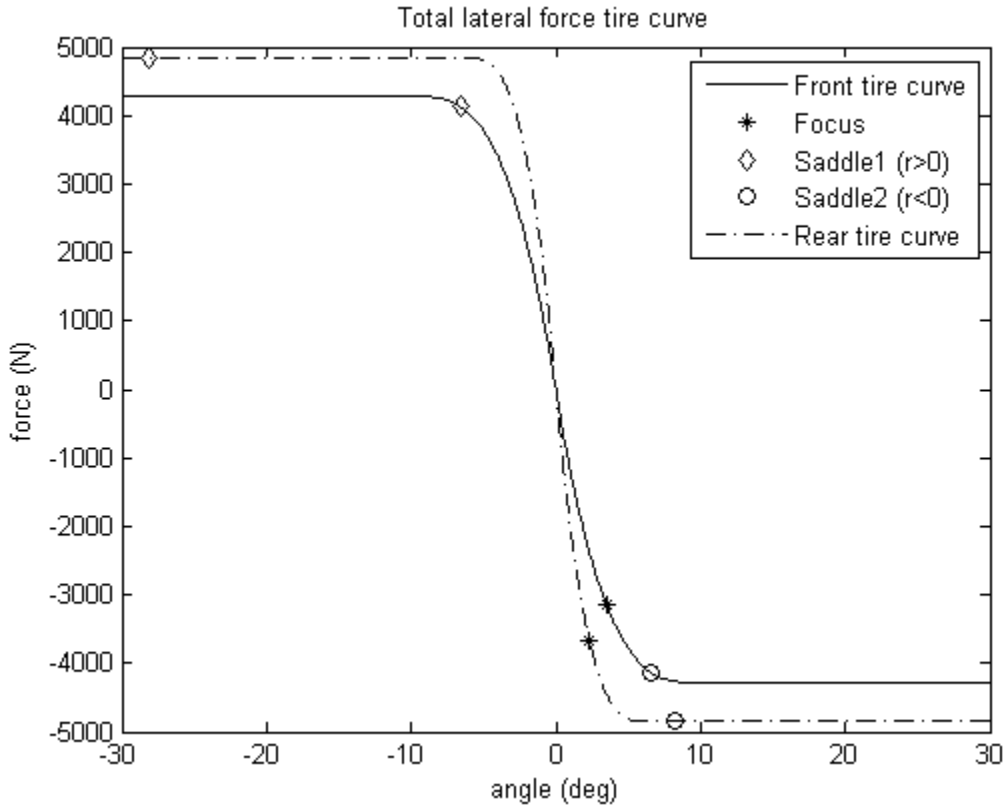
See below. The eigenvalues are close to what PPlane gives, which is what we expect, but vary slightly since we did not assume that v = Ux when solving for the roots of the characteristic equation.

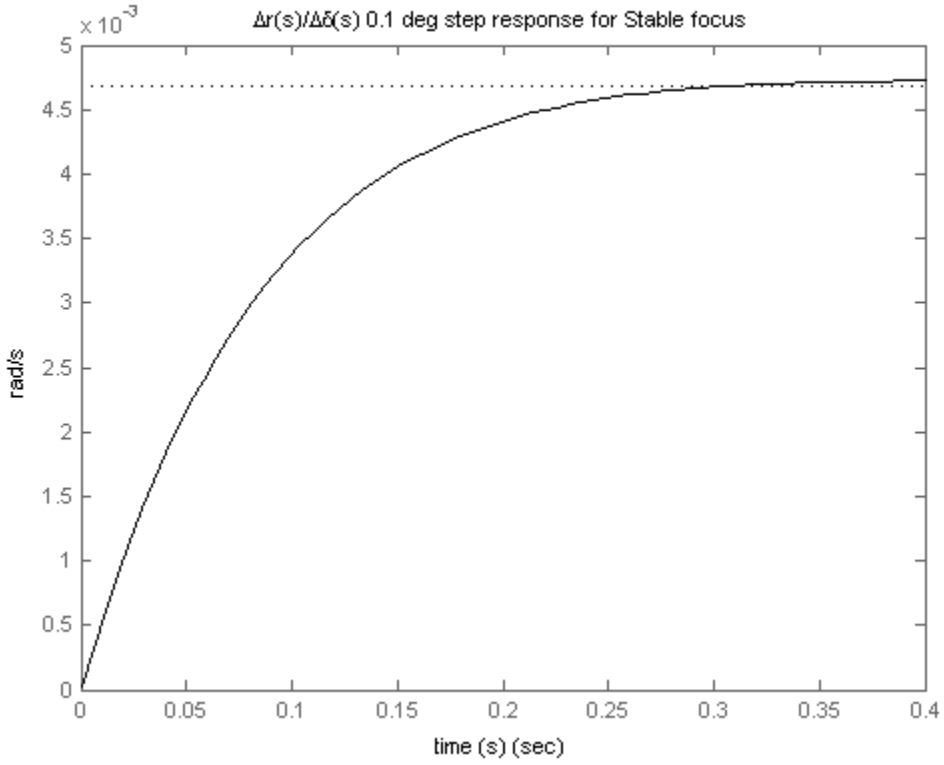
```
K =
    0.0740      -Inf      -Inf
```

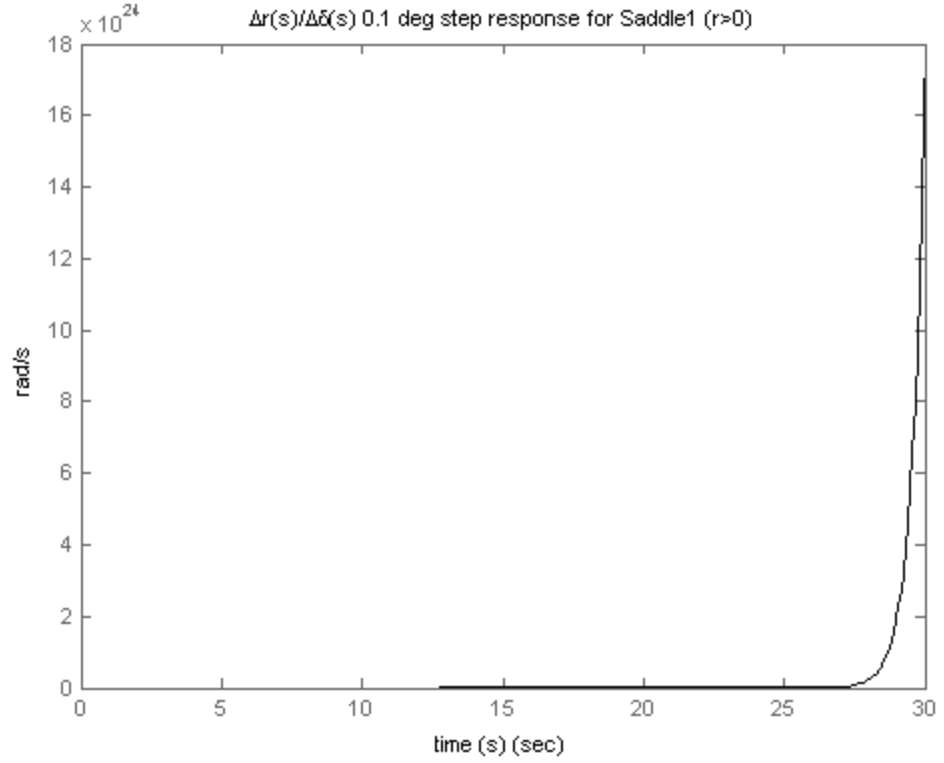
```
eigvalues =

   -9.0627 + 1.5227i   -4.0596            -4.1447
   -9.0627 - 1.5227i    2.1368             2.0853
```

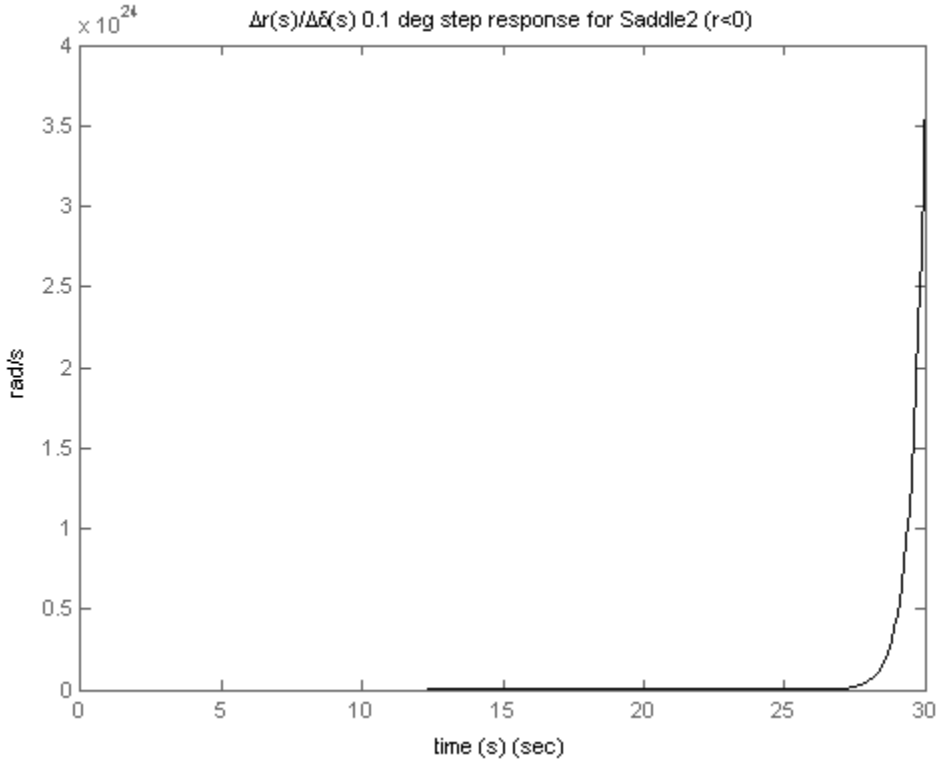
2(b) Yaw rate step response to small steering perturbation

Only our stable equilibrium has a stable step response, as expected.



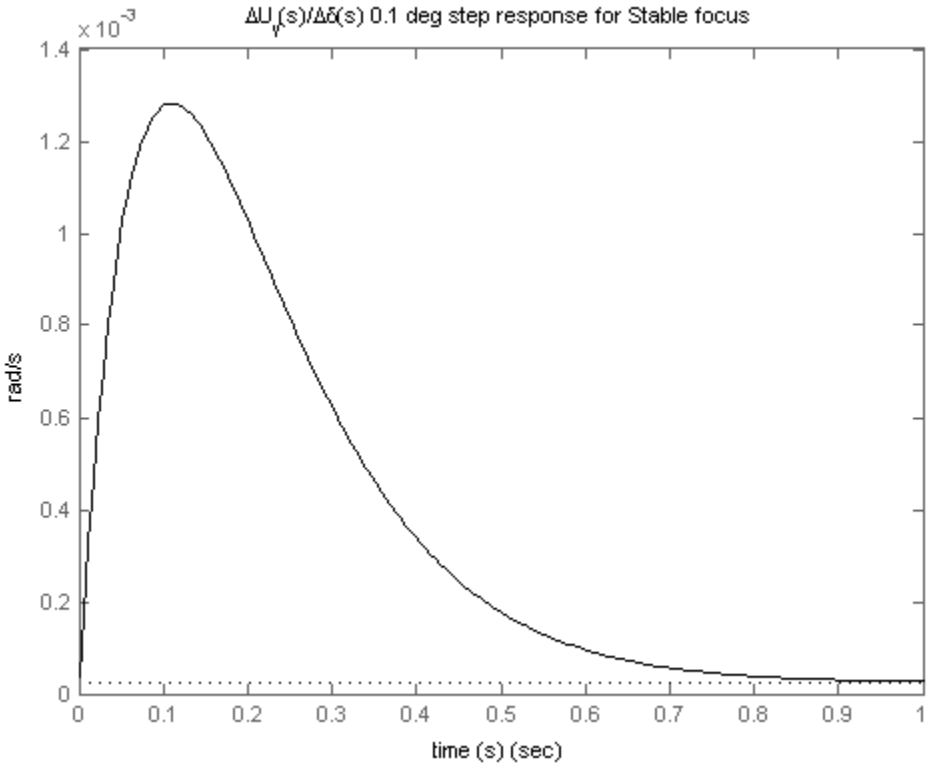

Δr(s)/Δδ(s) 0.1 deg step response for Stable focus
x 10^-3
rad/s
time (s) (sec)

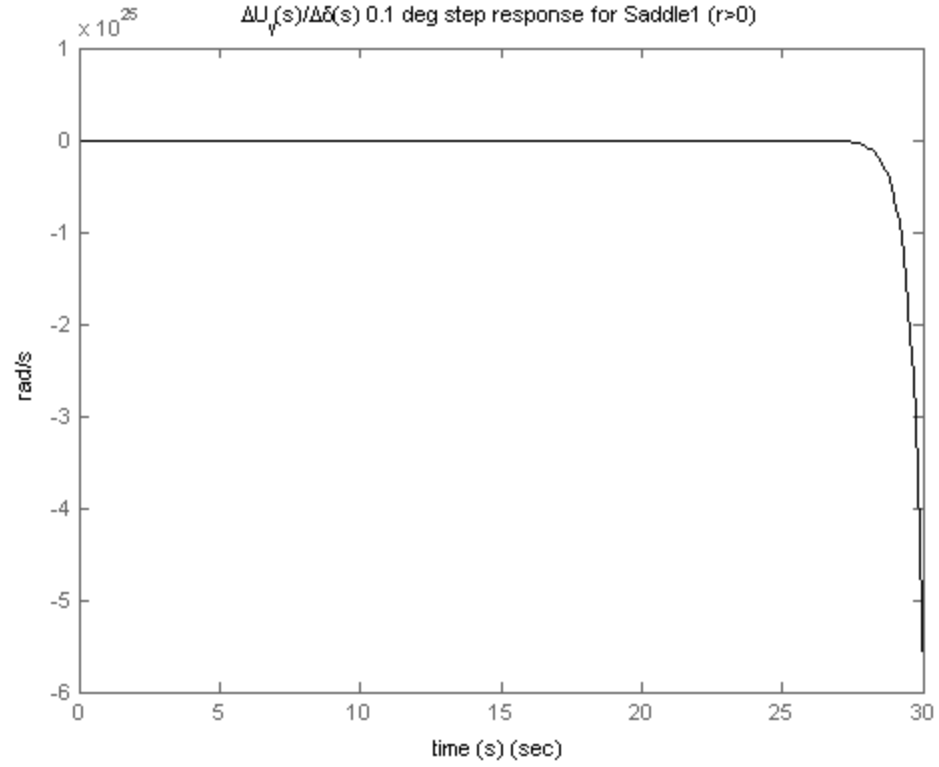

Δr(s)/Δδ(s) 0.1 deg step response for Saddle1 (r>0)
x 10^24
rad/s
time (s) (sec)

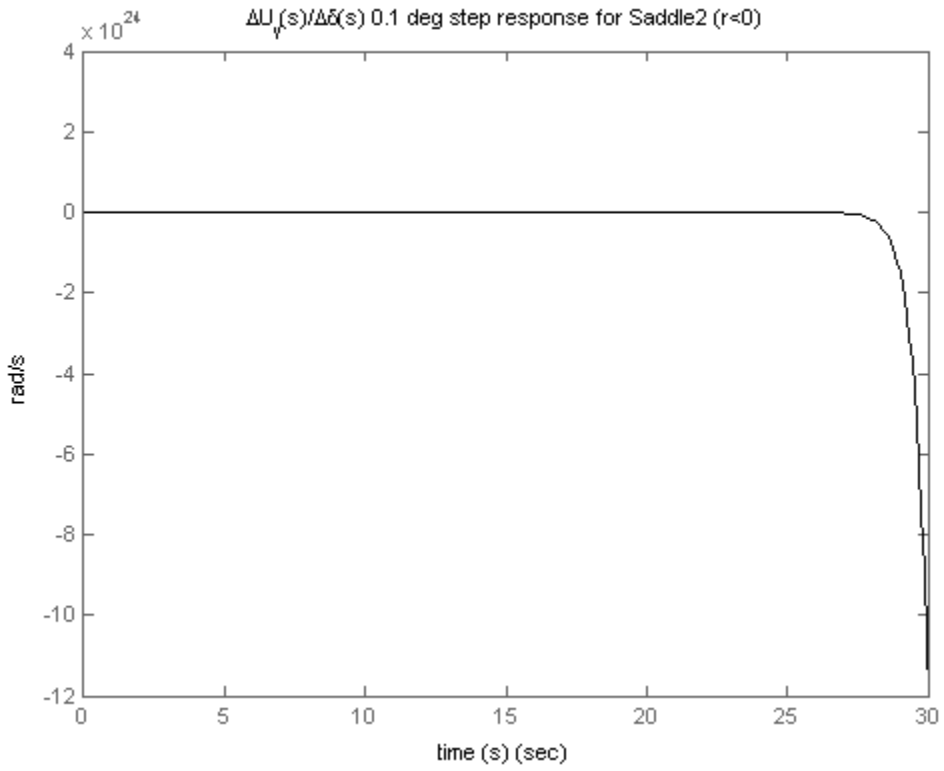


2(c) Uy step response to small steering perturbation

Only our stable equilibrium has a stable step response, as expected.


ΔU_v(s)/Δδ(s) 0.1 deg step response for Stable focus
x 10^-3
1.4
1.2
1
0.8
0.6
0.4
0.2
0
rad/s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
time (s) (sec)


ΔU_v(s)/Δδ(s) 0.1 deg step response for Saddle1 (r>0)
x 10^25
1
0
-1
-2
-3
-4
-5
-6
rad/s
0
5
10
15
20
25
30
time (s) (sec)



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