Project_Code_1b.m

By Joshua Norlin This project code calculates the characteristic exponents of the rotor system without reversed flow for values B=0.98 and p=1.2, determines the stability of the system, and plots the results. Stable1 and Stable2 contain a true/false analysis for each characteristic exponent's stability, and Nu contains the characteristic exponent pairs. For gamma=0:16, values 1:17 correspond with mu=0, values 18:34 correspond with mu=1, and values 35:51 correspond with mu=2.

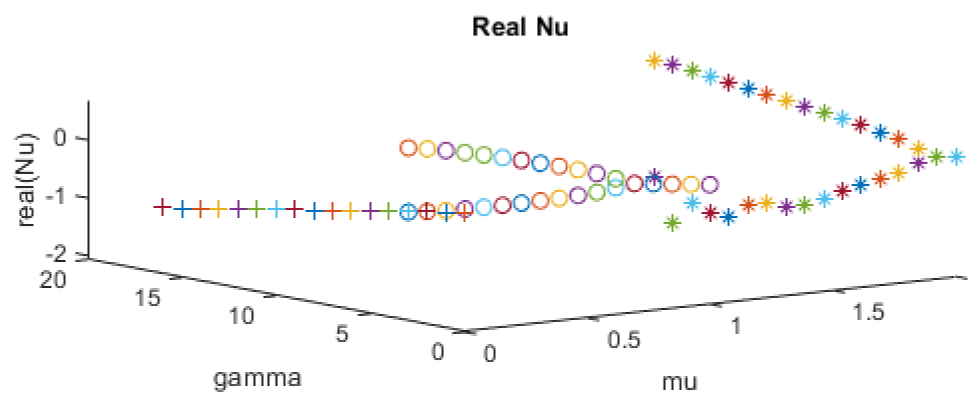
```
t = 0:pi/8:2*pi;
conditions1 = [1 0];
conditions2 = [0 1];
Q = []; % Matrix of transition matricies; Values 1:34 are for mu=0,
 35:69
% are for mu=1, 70:102 are for mu=2.
Lambda = []; % Eigenvalues of transition matricies
Nu = []; % Natural logarithms of transition matricies
Stable1 = []; % Values of stability for Nu, 1=stable, 0=unstable
Stable2 = []; % Values of stability for Nu, 1=stable, 0=unstable
% Values 1:17 are for mu=0, gamma=0:16, 18:34 are for mu=1, and 35:51
 are
% for mu=2.
for mu = 0:2
    for gamma = 0:16
        [t,beta2] =
 ode45(@(t,beta)rhs(t,beta,mu,gamma),t,conditions2);
        [t,beta1] =
 ode45(@(t,beta)rhs(t,beta,mu,gamma),t,conditions1);
        Beta1 = beta1(:,1);
        Beta2 = beta2(:,1);
        dBeta1dt = beta1(:,2);
        dBeta2dt = beta2(:,2);
        period1a = Beta1(length(t));
        period1b = dBeta1dt(length(t));
        period2a = Beta2(length(t));
        period2b = dBeta2dt(length(t));
        q = [period1a period2a; period1b period2b];
        lambda = eig(q);
        nu = (1/(2*pi))*log(lambda);
       if real(nu(1)) <= 0
            stable1 = 1;
        elseif real(nu(1)) > 0
            stable1 = 0;
        end
        Stable1 = [Stable1 stable1];
        if real(nu(2)) <= 0
            stable2 = 1;
        elseif real(nu(2)) > 0
            stable2 = 0;
        end
        Stable2 = [Stable2 stable2];
        Q = [Q q];
        Lambda = [Lambda lambda];
```

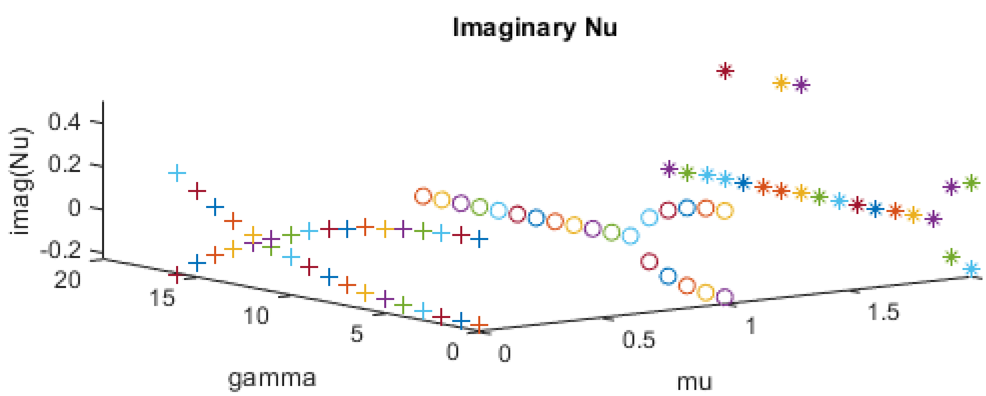
```
        Nu = [Nu nu];
    end
end
figure
hold on
mu = 0:2;
gamma = 0:16;
subplot(2,1,1)
for i = 1:length(gamma)
    plot3(mu(1),gamma(i),real(Nu(:,i)),'+')
    hold on
    plot3(mu(2),gamma(i),real(Nu(:,17+i)),'o')
    hold on
    plot3(mu(3),gamma(i),real(Nu(:,34+i)),'*')
    hold on
end
title('Real Nu')
xlabel('mu')
ylabel('gamma')
zlabel('real(Nu)')
subplot(2,1,2)
for i = 1:length(gamma)
     plot3(mu(1),gamma(i),imag(Nu(:,i)),'+')
    hold on
    plot3(mu(2),gamma(i),imag(Nu(:,17+i)),'o')
    hold on
    plot3(mu(3),gamma(i),imag(Nu(:,34+i)),'*')
    hold on
end
title('Imaginary Nu')
xlabel('mu')
ylabel('gamma')
zlabel('imag(Nu)')
Nu
Stable1
Stable2


function dbetadt = rhs(t,beta,mu,gamma)
B = 0.98;
p = 1.2;
K1 = gamma.*((B.^3).*mu.*cos(t)/6 + (B.^2).*(mu.^2).*sin(2.*t)/8);
K = K1;
C1 = gamma.*((B.^4)/8 + (B.^3).*mu.*sin(t)/6);
C = C1;
dbetadt_1 = beta(2);
dbetadt_2 = -(p.^2 + K).*beta(1) - C.*beta(2);
dbetadt = [dbetadt_1; dbetadt_2];
end


Nu =

  Columns 1 through 4
```

```
 -0.0000 + 0.2001i  -0.0577 + 0.1987i  -0.1154 + 0.1945i  -0.1730 +
0.1875i
 -0.0000 - 0.2001i  -0.0577 - 0.1987i  -0.1154 - 0.1945i  -0.1730 -
0.1875i

 Columns 5 through 8

 -0.2307 + 0.1776i  -0.2883 + 0.1648i  -0.3460 + 0.1490i  -0.4036 +
0.1300i
 -0.2307 - 0.1776i  -0.2883 - 0.1648i  -0.3460 - 0.1490i  -0.4036 -
0.1300i

 Columns 9 through 12

 -0.4612 + 0.1077i  -0.5188 + 0.0819i  -0.5764 + 0.0523i  -0.6340 +
0.0187i
 -0.4612 - 0.1077i  -0.5188 - 0.0819i  -0.5764 - 0.0523i  -0.6340 -
0.0187i

 Columns 13 through 16

 -0.6917 + 0.0195i  -0.7493 + 0.0628i  -0.8070 + 0.1119i  -0.8646 +
0.1679i
 -0.6917 - 0.0195i  -0.7493 - 0.0628i  -0.8070 - 0.1119i  -0.8646 -
0.1679i

 Columns 17 through 20

 -0.9223 + 0.2322i  -0.0000 + 0.2001i  -0.0577 + 0.1954i  -0.1153 +
0.1805i
 -0.9223 - 0.2322i  -0.0000 - 0.2001i  -0.0577 - 0.1954i  -0.1153 -
0.1805i

 Columns 21 through 24

 -0.1730 + 0.1527i  -0.2306 + 0.1020i  -0.2100 + 0.0000i  -0.1842 +
0.0000i
 -0.1730 - 0.1527i  -0.2306 - 0.1020i  -0.3666 + 0.0000i  -0.5078 +
0.0000i

 Columns 25 through 28

 -0.1810 + 0.0000i  -0.1855 + 0.0000i  -0.1944 + 0.0000i  -0.2065 +
0.0000i
 -0.6263 + 0.0000i  -0.7369 + 0.0000i  -0.8434 + 0.0000i  -0.9461 +
0.0000i

 Columns 29 through 32

 -0.2216 + 0.0000i  -0.2399 + 0.0000i  -1.2364 + 0.0000i  -1.3262 +
0.0000i
 -1.0468 + 0.0000i  -1.1437 + 0.0000i  -0.2618 + 0.0000i  -0.2886 +
0.0000i
```

```
  Columns 33 through 36

  -1.4069 + 0.0000i  -1.4788 + 0.0000i  -0.0000 + 0.2001i  -0.0577 +
 0.1618i
  -0.3222 + 0.0000i  -0.3666 + 0.0000i  -0.0000 - 0.2001i  -0.0577 -
 0.1618i

  Columns 37 through 40

   0.0039 + 0.0000i   0.1077 + 0.0000i   0.1759 + 0.0000i   0.2333 +
 0.0000i
  -0.2345 + 0.0000i  -0.4543 + 0.0000i  -0.6355 + 0.0000i  -0.8077 +
 0.0000i

  Columns 41 through 44

   0.2848 + 0.0000i   0.3323 + 0.0000i   0.3768 + 0.0000i   0.4190 +
 0.0000i
  -0.9658 + 0.0000i  -1.1542 + 0.0000i  -1.3379 + 0.0000i  -1.4329 +
 0.5000i

  Columns 45 through 48

   0.4591 + 0.0000i   0.4977 + 0.0000i   0.5346 + 0.0000i   0.5702 +
 0.0000i
  -1.4274 + 0.5000i  -1.5125 + 0.0000i  -1.7819 + 0.0000i  -1.7936 +
 0.5000i

  Columns 49 through 51

   0.6044 + 0.0000i   0.6372 + 0.0000i   0.6685 + 0.0000i
  -1.6761 + 0.0000i  -2.0708 + 0.0000i  -1.3449 + 0.0000i


Stable1 =

  Columns 1 through 13

     1     1     1     1     1     1     1     1     1     1     1
 1     1

  Columns 14 through 26

     1     1     1     1     1     1     1     1     1     1     1
 1     1

  Columns 27 through 39

     1     1     1     1     1     1     1     1     1     1     0
 0     0

  Columns 40 through 51
```

```
    0     0     0     0     0     0     0     0     0     0     0
  0


Stable2 =

  Columns 1 through 13

    1     1     1     1     1     1     1     1     1     1     1
 1     1

  Columns 14 through 26

    1     1     1     1     1     1     1     1     1     1     1
 1     1

  Columns 27 through 39

    1     1     1     1     1     1     1     1     1     1     1
 1     1

  Columns 40 through 51

    1     1     1     1     1     1     1     1     1     1     1
  1
```





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