Project_Code_2b.m

By Joshua Norlin This project code calculates the characteristic exponents of the rotor system with 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];
```

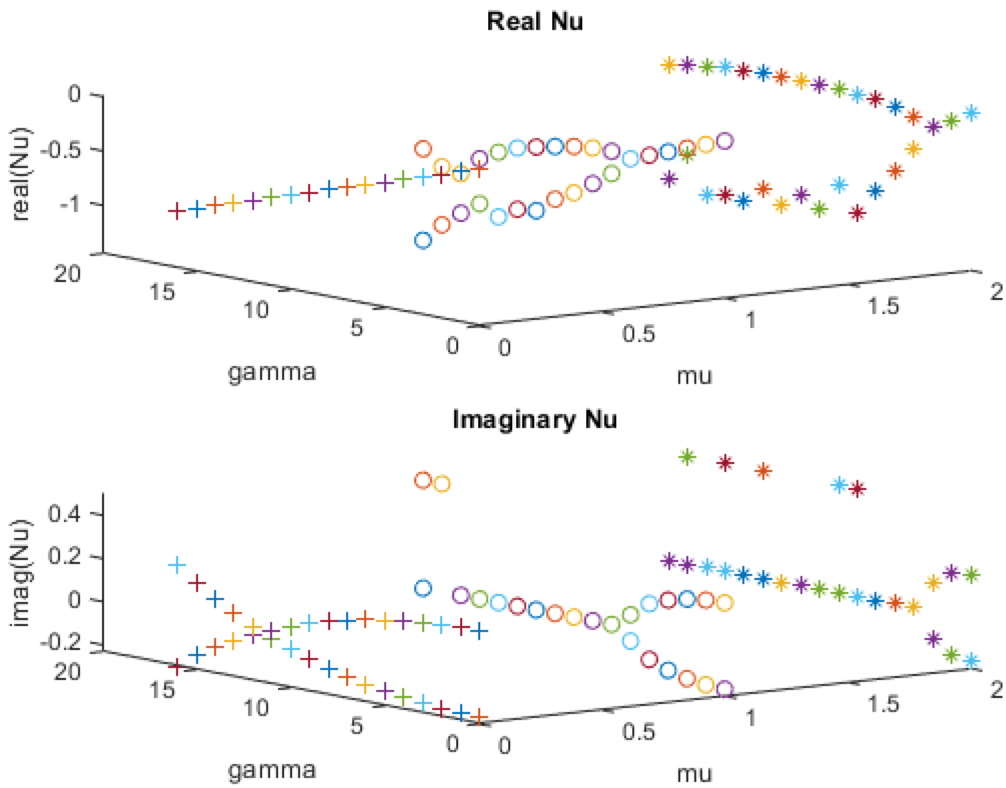
```
        Nu = [Nu nu];
    end
end
figure
hold on
mu = 0:2;
gamma = 0:16;
subplot(2,1,1)
for i = 1:length(gamma)
    plot3(mu(1),gamma(i),real(Nu(:,i)),'+')
    hold on
    plot3(mu(2),gamma(i),real(Nu(:,17+i)),'o')
    hold on
    plot3(mu(3),gamma(i),real(Nu(:,34+i)),'*')
    hold on
end
title('Real 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);
K2 = K1 + gamma.*(mu.^4)*(-sin(2.*t)/24 + sin(4.*t)/48);
K3 = -K1;
C1 = gamma.*((B.^4)/8 + (B.^3).*mu.*sin(t)/6);
C2 = C1 + gamma.*(mu.^4).*(1/32 - cos(2.*t)/24 - cos(4.*t)/96);
C3 = -C1;
if mu*sin(t) > -B && mu*sin(t) < 0
    K = K2;
    C = C2;
elseif mu*sin(t) <= -B
    K = K3;
    C = C3;
else
```

```
    K = K1;
    C = C1;
end
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  -0.0660 + 0.1962i  -0.1319 +
 0.1843i
  -0.9223 - 0.2322i  -0.0000 - 0.2001i  -0.0660 - 0.1962i  -0.1319 -
 0.1843i

  Columns 21 through 24

  -0.1986 + 0.1628i  -0.2649 + 0.1290i  -0.3303 + 0.0610i  -0.2943 +
 0.0000i
  -0.1986 - 0.1628i  -0.2649 - 0.1290i  -0.3303 - 0.0610i  -0.4996 +
 0.0000i

  Columns 25 through 28
```

```
  -0.2970 + 0.0000i  -0.3177 + 0.0000i  -0.3503 + 0.0000i  -0.3885 +
 0.0000i
  -0.6252 + 0.0000i  -0.7434 + 0.0000i  -0.8352 + 0.0000i  -0.9745 +
 0.0000i

  Columns 29 through 32

  -0.4314 + 0.0000i  -0.5021 + 0.0000i  -0.5973 + 0.0000i  -0.7679 +
 0.0000i
  -0.9947 + 0.0000i  -1.0979 + 0.0000i  -1.0101 + 0.0000i  -1.1304 +
 0.0000i

  Columns 33 through 36

  -1.2710 + 0.5000i  -1.4465 + 0.0000i  -0.0000 + 0.2001i  -0.0954 +
 0.1899i
  -0.7365 + 0.5000i  -0.6048 + 0.5000i  -0.0000 - 0.2001i  -0.0954 -
 0.1899i

  Columns 37 through 40

  -0.1946 + 0.1307i  -0.1362 + 0.0000i  -0.0768 + 0.0000i  -0.0431 +
 0.0000i
  -0.1946 - 0.1307i  -0.4228 + 0.0000i  -0.6693 + 0.0000i  -0.8907 +
 0.0000i

  Columns 41 through 44

  -0.0322 + 0.0000i  -0.0114 + 0.0000i  -0.0013 + 0.0000i   0.0026 +
 0.0000i
  -1.1131 + 0.5000i  -0.8943 + 0.5000i  -1.1395 + 0.0000i  -1.0468 +
 0.0000i

  Columns 45 through 48

   0.0080 + 0.0000i   0.0012 + 0.0000i  -0.0081 + 0.0000i  -0.0126 +
 0.0000i
  -1.1813 + 0.0000i  -1.0558 + 0.5000i  -1.2038 + 0.0000i  -1.1772 +
 0.5000i

  Columns 49 through 51

  -0.0322 + 0.0000i  -0.0567 + 0.0000i  -0.0952 + 0.0000i
  -1.2241 + 0.0000i  -0.8761 + 0.5000i  -1.1446 + 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     1
1     1

  Columns 40 through 51

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


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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