Project_Code_1.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=0.8, 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];
```

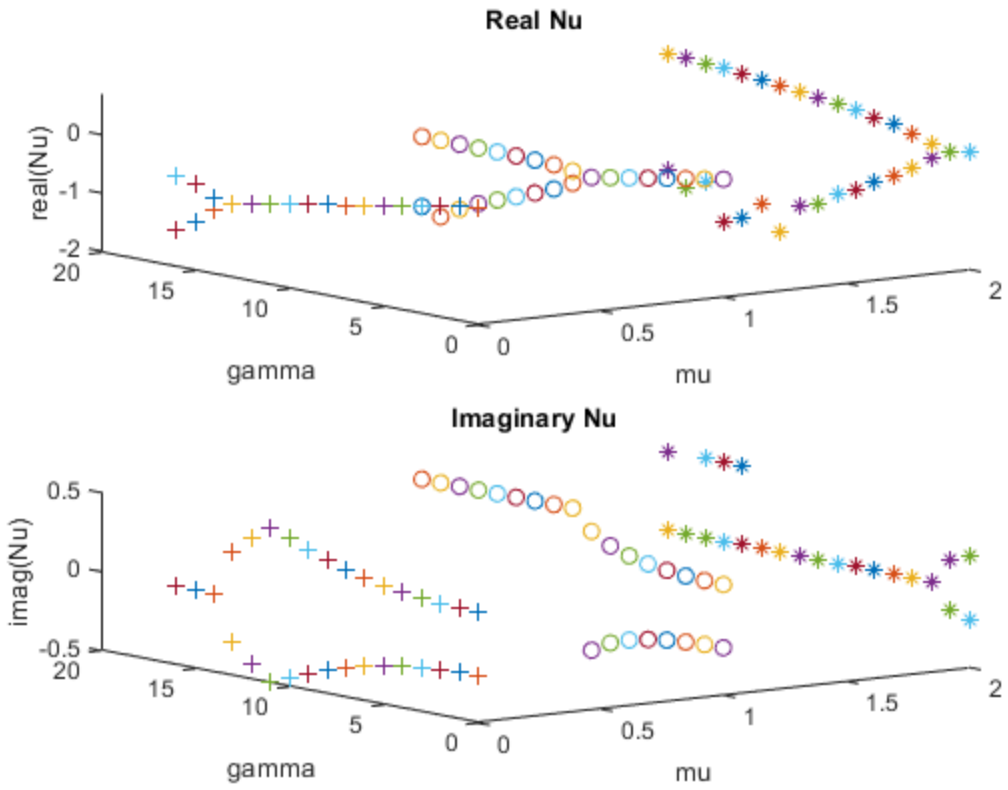
```
        Nu = [Nu nu];
    end
end
figure
hold on
mu = 0:2;
gamma = 0:16;
subplot(2,1,1)
for i = 1:length(gamma)
    plot3(mu(1),gamma(i),real(Nu(:,i)),'+')
    hold on
    plot3(mu(2),gamma(i),real(Nu(:,17+i)),'o')
    hold on
    plot3(mu(3),gamma(i),real(Nu(:,34+i)),'*')
    hold on
end
title('Real 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 = 0.8;
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 + 0.2000i  -0.0577 + 0.2021i  -0.1153 + 0.2084i  -0.1730 +
0.2189i
 -0.0000 - 0.2000i  -0.0577 - 0.2021i  -0.1153 - 0.2084i  -0.1730 -
0.2189i

 Columns 5 through 8

 -0.2306 + 0.2340i  -0.2882 + 0.2537i  -0.3459 + 0.2786i  -0.4035 +
0.3092i
 -0.2306 - 0.2340i  -0.2882 - 0.2537i  -0.3459 - 0.2786i  -0.4035 -
0.3092i

 Columns 9 through 12

 -0.4612 + 0.3463i  -0.5188 + 0.3911i  -0.5765 + 0.4453i  -0.6341 +
0.4877i
 -0.4612 - 0.3463i  -0.5188 - 0.3911i  -0.5765 - 0.4453i  -0.6341 -
0.4877i

 Columns 13 through 16

 -0.6918 + 0.4018i  -0.7494 + 0.2799i  -0.7005 + 0.0000i  -0.5365 +
0.0000i
 -0.6918 - 0.4018i  -0.7494 - 0.2799i  -0.9137 + 0.0000i  -1.1928 +
0.0000i

 Columns 17 through 20

 -0.4633 + 0.0000i  -0.0000 + 0.2000i  -0.0577 + 0.2021i  -0.1153 +
0.2087i
 -1.3811 + 0.0000i  -0.0000 - 0.2000i  -0.0577 - 0.2021i  -0.1153 -
0.2087i

 Columns 21 through 24

 -0.1729 + 0.2205i  -0.2306 + 0.2388i  -0.2883 + 0.2661i  -0.3459 +
0.3071i
 -0.1729 - 0.2205i  -0.2306 - 0.2388i  -0.2883 - 0.2661i  -0.3459 -
0.3071i

 Columns 25 through 28

 -0.4035 + 0.3761i  -0.5674 + 0.5000i  -0.7259 + 0.5000i  -0.8589 +
0.5000i
 -0.4035 - 0.3761i  -0.3551 + 0.5000i  -0.3118 + 0.5000i  -0.2939 +
0.5000i

 Columns 29 through 32

 -0.9845 + 0.5000i  -1.1048 + 0.5000i  -1.2267 + 0.5000i  -1.3877 +
0.5000i
 -0.2842 + 0.5000i  -0.2782 + 0.5000i  -0.2741 + 0.5000i  -0.2707 +
0.5000i
```

```
 Columns 33 through 36

 -1.5791 + 0.5000i  -1.4637 + 0.5000i  -0.0000 + 0.2000i  -0.0576 +
0.1604i
 -0.2675 + 0.5000i  -0.2640 + 0.5000i  -0.0000 - 0.2000i  -0.0576 -
0.1604i

 Columns 37 through 40

  0.0190 + 0.0000i   0.1293 + 0.0000i   0.2070 + 0.0000i   0.2723 +
0.0000i
 -0.2497 + 0.0000i  -0.4752 + 0.0000i  -0.6681 + 0.0000i  -0.8504 +
0.0000i

 Columns 41 through 44

  0.3295 + 0.0000i   0.3806 + 0.0000i   0.4268 + 0.0000i   0.4691 +
0.0000i
 -1.0264 + 0.0000i  -1.1667 + 0.0000i  -1.3985 + 0.0000i  -1.5052 +
0.0000i

 Columns 45 through 48

  0.5083 + 0.0000i   0.5446 + 0.0000i   0.5784 + 0.0000i   0.6098 +
0.0000i
 -2.0156 + 0.0000i  -1.5845 + 0.0000i  -1.9037 + 0.5000i  -2.0270 +
0.5000i

 Columns 49 through 51

  0.6389 + 0.0000i   0.6655 + 0.0000i   0.6892 + 0.0000i
 -1.3920 + 0.5000i  -1.5547 + 0.0000i  -1.3284 + 0.5000i


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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