Project_Code_1c.m

By Joshua Norlin This project code calculates the characteristic exponents of the rotor system without reversed flow for values B=1 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];
```

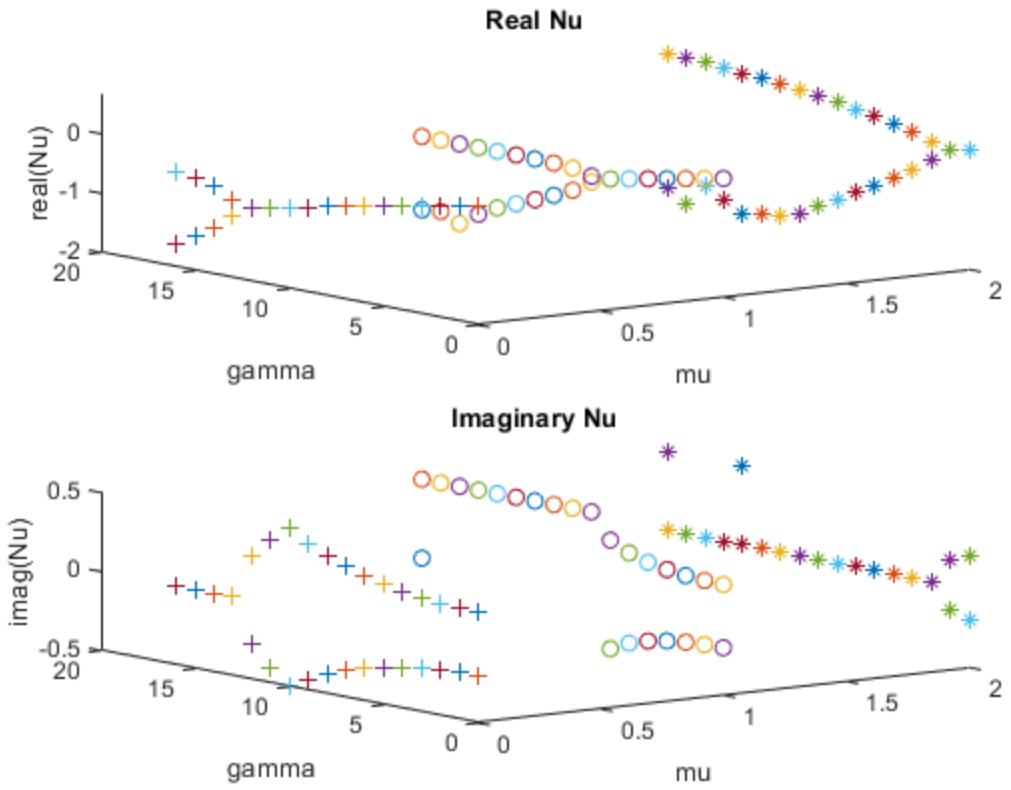
```
        Nu = [Nu nu];
    end
end
figure
hold on
mu = 0:2;
gamma = 0:16;
subplot(2,1,1)
for i = 1:length(gamma)
    plot3(mu(1),gamma(i),real(Nu(:,i)),'+')
    hold on
    plot3(mu(2),gamma(i),real(Nu(:,17+i)),'o')
    hold on
    plot3(mu(3),gamma(i),real(Nu(:,34+i)),'*')
    hold on
end
title('Real 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 = 1;
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  -0.0625 + 0.2024i  -0.1250 + 0.2098i  -0.1875 +
0.2223i
 -0.0000 - 0.2000i  -0.0625 - 0.2024i  -0.1250 - 0.2098i  -0.1875 -
0.2223i

 Columns 5 through 8

 -0.2500 + 0.2401i  -0.3125 + 0.2636i  -0.3750 + 0.2933i  -0.4375 +
0.3302i
 -0.2500 - 0.2401i  -0.3125 - 0.2636i  -0.3750 - 0.2933i  -0.4375 -
0.3302i

 Columns 9 through 12

 -0.5000 + 0.3755i  -0.5625 + 0.4311i  -0.6250 + 0.4994i  -0.6875 +
0.4091i
 -0.5000 - 0.3755i  -0.5625 - 0.4311i  -0.6250 - 0.4994i  -0.6875 -
0.4091i

 Columns 13 through 16

 -0.7500 + 0.2784i  -0.6705 + 0.0000i  -0.5206 + 0.0000i  -0.4487 +
0.0000i
 -0.7500 - 0.2784i  -0.9544 + 0.0000i  -1.2293 + 0.0000i  -1.4258 +
0.0000i

 Columns 17 through 20

 -0.4000 + 0.0000i  -0.0000 + 0.2000i  -0.0625 + 0.2026i  -0.1250 +
0.2109i
 -1.5991 + 0.0000i  -0.0000 - 0.2000i  -0.0625 - 0.2026i  -0.1250 -
0.2109i

 Columns 21 through 24

 -0.1875 + 0.2257i  -0.2500 + 0.2492i  -0.3126 + 0.2853i  -0.3751 +
0.3436i
 -0.1875 - 0.2257i  -0.2500 - 0.2492i  -0.3126 - 0.2853i  -0.3751 -
0.3436i

 Columns 25 through 28

 -0.4867 + 0.5000i  -0.6867 + 0.5000i  -0.8330 + 0.5000i  -0.9677 +
0.5000i
 -0.3883 + 0.5000i  -0.3132 + 0.5000i  -0.2919 + 0.5000i  -0.2819 +
0.5000i

 Columns 29 through 32

 -1.0981 + 0.5000i  -1.2275 + 0.5000i  -1.3955 + 0.5000i  -1.6134 +
0.5000i
 -0.2768 + 0.5000i  -0.2741 + 0.5000i  -0.2726 + 0.5000i  -0.2715 +
0.5000i
```

```
 Columns 33 through 36

 -1.4714 + 0.5000i  -1.5037 + 0.0000i  -0.0000 + 0.2000i  -0.0625 +
0.1574i
 -0.2703 + 0.5000i  -0.2685 + 0.5000i  -0.0000 - 0.2000i  -0.0625 -
0.1574i

 Columns 37 through 40

  0.0238 + 0.0000i   0.1305 + 0.0000i   0.2073 + 0.0000i   0.2720 +
0.0000i
 -0.2738 + 0.0000i  -0.5053 + 0.0000i  -0.7096 + 0.0000i  -0.8921 +
0.0000i

 Columns 41 through 44

  0.3285 + 0.0000i   0.3788 + 0.0000i   0.4242 + 0.0000i   0.4656 +
0.0000i
 -1.0761 + 0.0000i  -1.2462 + 0.0000i  -1.4105 + 0.0000i  -1.6222 +
0.0000i

 Columns 45 through 48

  0.5035 + 0.0000i   0.5383 + 0.0000i   0.5701 + 0.0000i   0.5989 +
0.0000i
 -1.7009 + 0.0000i  -1.7249 + 0.0000i  -1.8102 + 0.5000i  -1.6233 +
0.0000i

 Columns 49 through 51

  0.6244 + 0.0000i   0.6460 + 0.0000i   0.6625 + 0.0000i
 -1.4611 + 0.0000i  -1.8269 + 0.0000i  -1.6083 + 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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