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% Matt McDade
% System Simulation
% Homework 10 Part F

N = 10000;
t = linspace(0, 10, N);

[A, B, C, D] = tf2ss([0.085],[1 0.4174 1.0871 0.2805 0.1512]);

T_rel_stable = 0.5;
T_com_stable = 0.01;
T_rel_unstable = 0.7;
T_com_unstable = 1;

x1 = zeros(1, N);
x2 = zeros(1, N);
x3 = zeros(1, N);
x4 = zeros(1, N);
fx1 = zeros(1, N);
fx2 = zeros(1, N);
fx3 = zeros(1, N);
fx4 = zeros(1, N);
y = zeros(1, N);

for k = 1:N-2
    fx1(k+1) = -0.4174*x1(k) - 1.0871*x2(k) - 0.2805*x3(k) -
    0.1512*x4(k) + 1;
    fx2(k+1) = x1(k);
    fx3(k+1) = x2(k);
    fx4(k+1) = x3(k);

    x1(k+2) = x1(k+1) + (T_rel_stable/2) * (3*fx1(k+1)-fx1(k));
    x2(k+2) = x2(k+1) + (T_rel_stable/2) * (3*fx2(k+1)-fx2(k));
    x3(k+2) = x3(k+1) + (T_rel_stable/2) * (3*fx3(k+1)-fx3(k));
    x4(k+2) = x4(k+1) + (T_rel_stable/2) * (3*fx4(k+1)-fx4(k));

    y(k) = 0.085*x4(k);
end

figure(1)
subplot(121)
plot(y, t)
title('T: Relatively Stable')

x1 = zeros(1, N);
x2 = zeros(1, N);
x3 = zeros(1, N);
x4 = zeros(1, N);
fx1 = zeros(1, N);
fx2 = zeros(1, N);
fx3 = zeros(1, N);
fx4 = zeros(1, N);
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y = zeros(1, N);

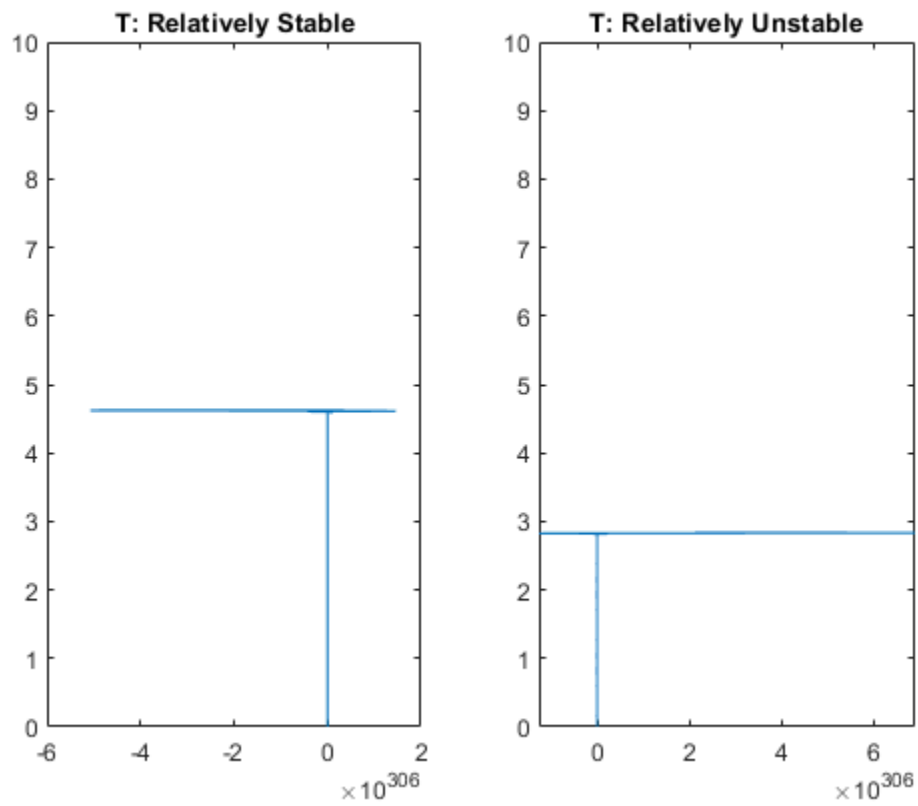
for k = 1:N-2
    fx1(k+1) = -0.4174*x1(k) - 1.0871*x2(k) - 0.2805*x3(k) -
    0.1512*x4(k) + 1;
    fx2(k+1) = x1(k);
    fx3(k+1) = x2(k);
    fx4(k+1) = x3(k);

    x1(k+2) = x1(k+1) + (T_rel_unstable/2) * (3*fx1(k+1)-fx1(k));
    x2(k+2) = x2(k+1) + (T_rel_unstable/2) * (3*fx2(k+1)-fx2(k));
    x3(k+2) = x3(k+1) + (T_rel_unstable/2) * (3*fx3(k+1)-fx3(k));
    x4(k+2) = x4(k+1) + (T_rel_unstable/2) * (3*fx4(k+1)-fx4(k));

    y(k) = 0.085*x4(k);
end

subplot(122)
plot(y, t)
title('T: Relatively Unstable')

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