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%System Simulation
%Problem 07 -- Tyler Matthews

clc;
close all;

%Initial Conditions
T = .01;
start = 0;
steps = 10000;
t = linspace(start, T, steps);
tstep = (start-T)/steps; %time step

R = 28;

x = zeros(1, length(t));
y = zeros(1, length(t));
z = zeros(1, length(t));

fx = zeros(1, length(t));
fy = zeros(1, length(t));
fz = zeros(1, length(t));

x(1) = 1;
y(1) = 2;
z(1) = 10;

%AB-4 Setup
fx(1) = 10*(y(1)-x(1));
fy(1) = -1*x(1)*z(1) + R*x(1) - y(1);
fz(1) = x(1)*y(1) - (8/3)*z(1);
x(2) = x(1) + T*fx(1);
y(2) = y(1) + T*fy(1);
z(2) = z(1) + T*fz(1);

fx(2) = 10*(y(2)-x(2));
fy(2) = -1*x(2)*z(2) + R*x(2) - y(2);
fz(2) = x(2)*y(2) - (8/3)*z(2);
x(3)  = x(2) + (3/2)*T*fx(2) - (T/2)*fx(1);
y(3)  = y(2) + (3/2)*T*fy(2) - (T/2)*fy(1);
z(3)  = z(2) + (3/2)*T*fz(2) - (T/2)*fz(1);

fx(3) = 10*(y(3)-x(3));
fy(3) = -1*x(3)*z(3) + R*x(3) - y(3);
fz(3) = x(3)*y(3) - (8/3)*z(3);
x(4) = x(3) + (23/12)*T*fx(3) - (16/12)*T*fx(2) + (5/12)*T*fx(1);
y(4) = y(3) + (23/12)*T*fy(3) - (16/12)*T*fy(2) + (5/12)*T*fy(1);
z(4) = z(3) + (23/12)*T*fz(3) - (16/12)*T*fz(2) + (5/12)*T*fz(1);


%AB-4
for k=1 : steps
    x(k+4)  = x(k+3) + (55/24)*T*fx(k+3) - (59/24)*T*fx(k+2) + (37/24)*T*fx(k+1) - (9/24)*T*fx(k);
        y(k+4)  = y(k+3) + (55/24)*T*fy(k+3) - (59/24)*T*fy(k+2) + (37/24)*T*fy(k+1) - (9/24)*T*fy(k);
        z(k+4)  = z(k+3) + (55/24)*T*fz(k+3) - (59/24)*T*fz(k+2) + (37/24)*T*fz(k+1) - (9/24)*T*fz(k);

    fx(k+4) = 10*(y(k+4)-x(k+4));
    fy(k+4) = -1*x(k+4)*z(k+4) + R*x(k+4) - y(k+4);
        fz(k+4) = x(k+4)*y(k+4) - (8/3)*z(k+4);
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end

figure;
plot(x, y);
xlabel('x');
ylabel('y');

figure;
plot3(x,y,z);
xlabel('x');
ylabel('y');
zlabel('z');

%AB2 = x[k+2] = x[k] + (3/2)*T*f[k+1] - (T/2)*f[k]
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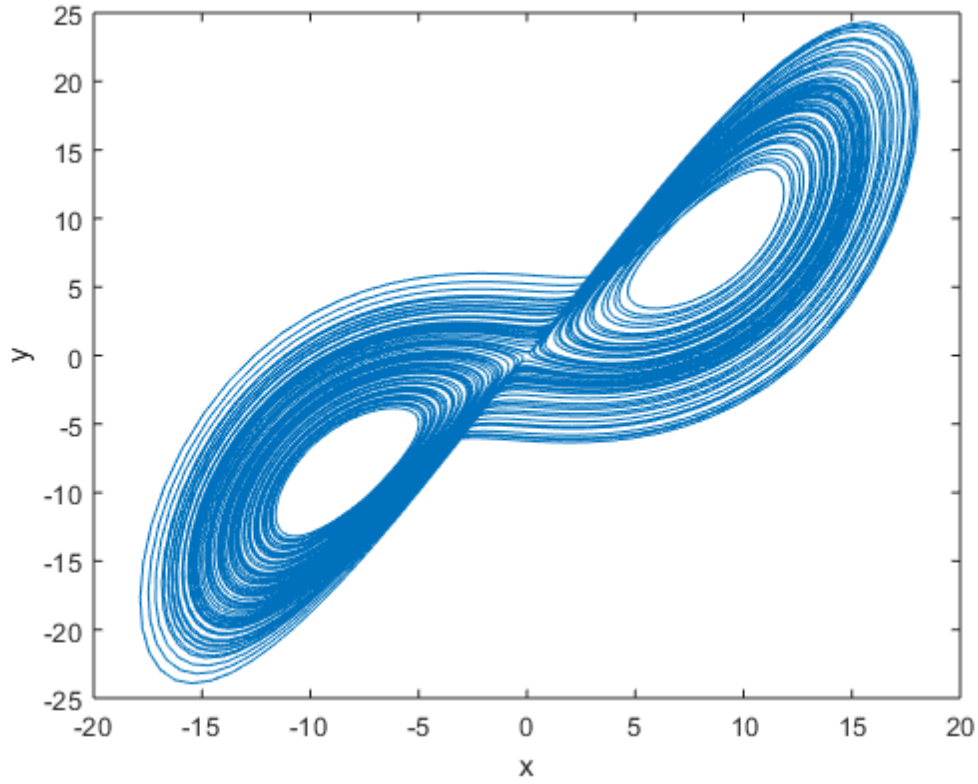

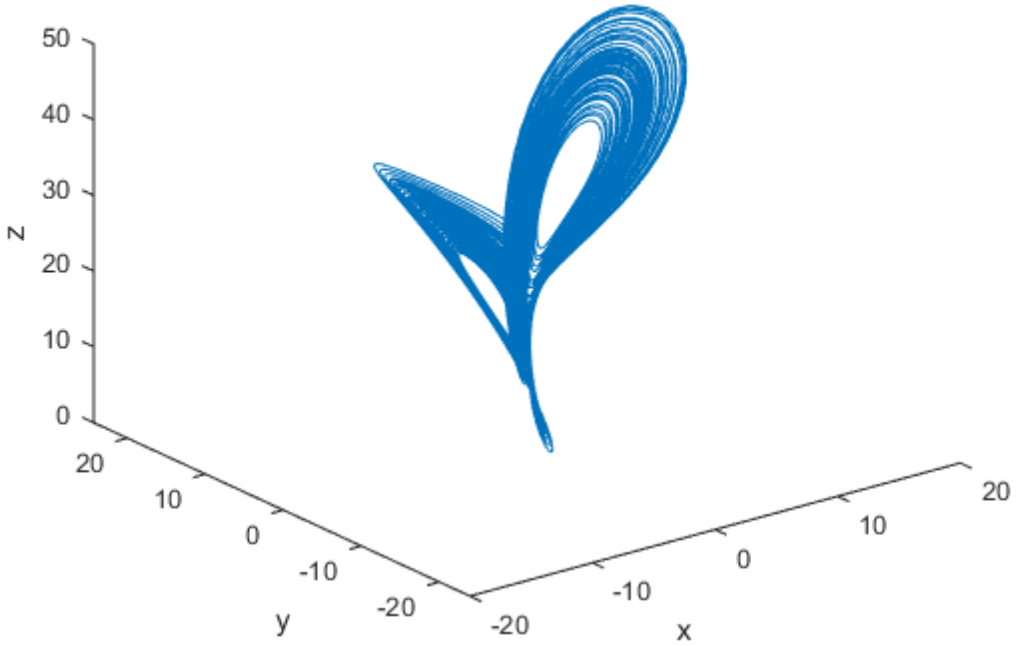

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