Contents

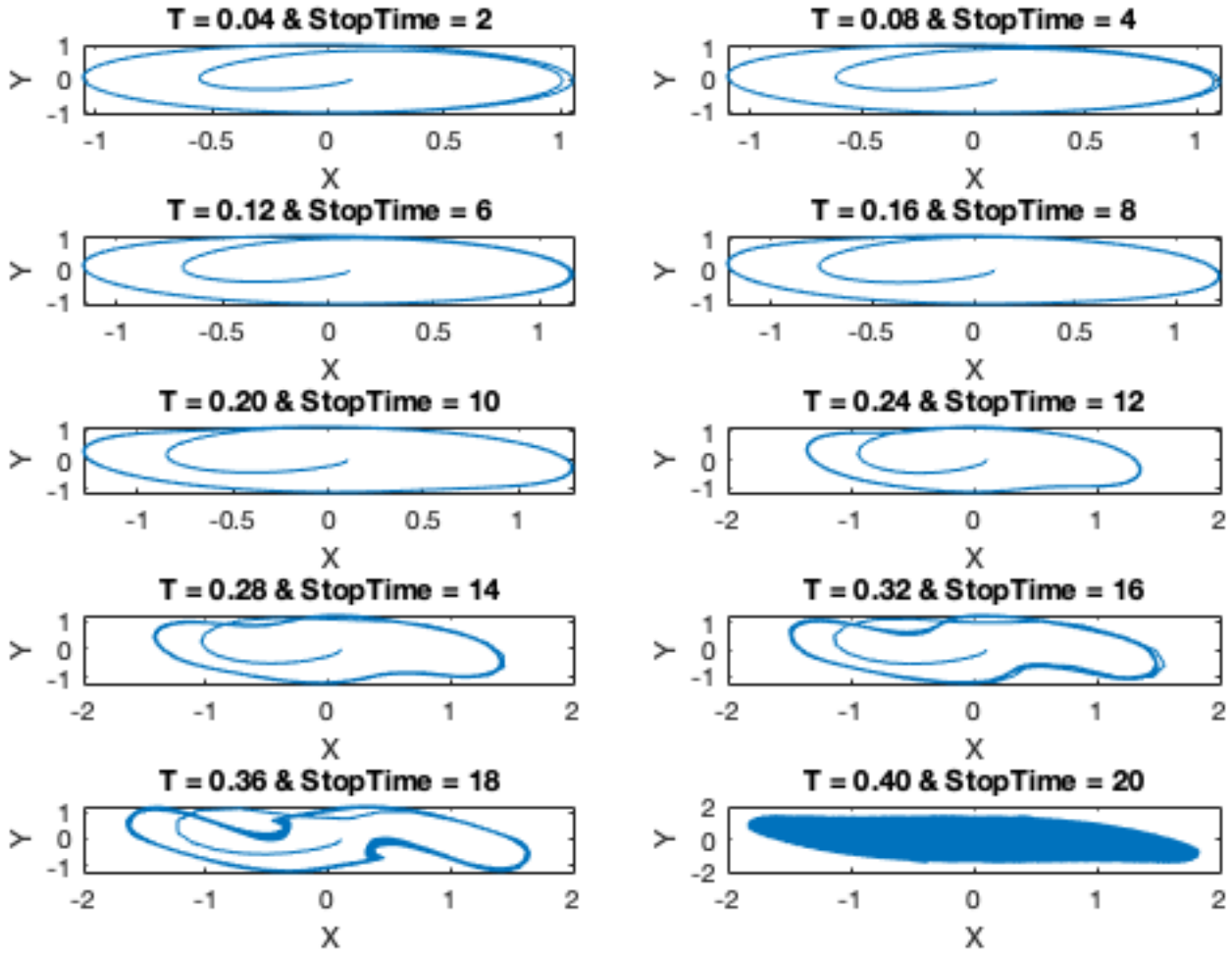

```
%Tyler Matthews
%System Simulation Project

disp('Decided to simulate two different systems using various values for the timestep and AB2
as the integrator')
```

```
Decided to simulate two different systems using various values for the timestep and AB2 as the
 integrator
```

SYSTEM 1

```
%{
dx/dt = y
dy/dt = (1 - x2 - y2)y - x
%}

clc; close all; clear all; %clear console, clear workspace, close figures
figure;
for j = 1:10

    startTime = 0;
    stopTime = 2*j;
    steps = 50000;

    T = (stopTime - startTime)/50;
    t = linspace(startTime, stopTime, steps);


    x = zeros(1, length(t));
    y = zeros(1, length(t));
    fx = zeros(1, length(t));
    fy  = zeros(1, length(t));

    x(1) = 0.1;
    y(1) = 0.005;

    fx(1) = y(1);
    fy(1) = y(1)*(1 - x(1)^2 - y(1)^2) - x(1);

    x(2) = x(1) + T*fx(1);%Euler
    y(2) = y(1) + T*fy(1);

    for k=3 : steps
        fx(k-1) =  y(k-2);
        fy(k-1) = y(k-2)*(1 - x(k-2)^2 - y(k-2)^2) - x(k-2);
        x(k) = x(k-1) + (3*T)./(2)*fx(k-1) - (T/2)*fx(k-2);%AB2
        y(k) = y(k-1) + (3*T)./(2)*fy(k-1) - (T/2)*fy(k-2);
```

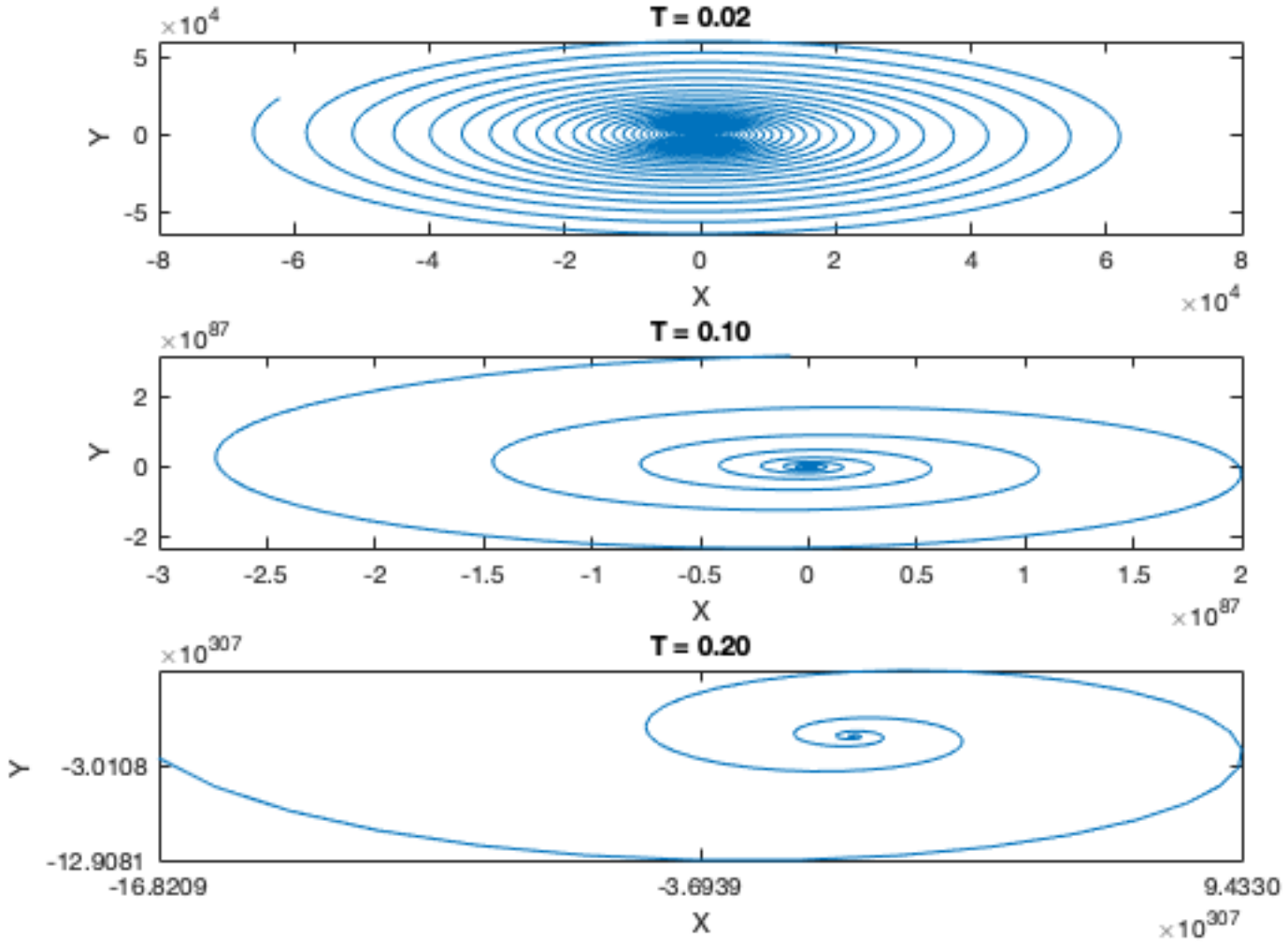
```
    end

    %PLOTTING
    subplot(5,2,j)
    t1 = sprintf("T = %0.2f & StopTime = %i", T,stopTime);
    plot(x, y)
    xlabel('X')
    ylabel('Y')
    title(t1)
end
```



System 2

```
%{
dx/dt = y
dy/dt = -x
%}
stopTimeArr = [1, 5, 10];

figure;
for j = 1:3

    startTime = 0;
    stopTime = stopTimeArr(j);
    steps = 20000;

    T = (stopTime - startTime)/50;
    t = linspace(startTime, stopTime, steps);
```

```
x = zeros(1, length(t));
y = zeros(1, length(t));
fx = zeros(1, length(t));
fy  = zeros(1, length(t));

x(1) = 20;
y(1) = 10;

fx(1) = y(1);
fy(1) = -x(1);

x(2) = x(1) + T*fx(1);
y(2) = y(1) + T*fy(1);

for k=3 : steps
    fx(k-1) =  y(k-2);
    fy(k-1) = -x(k-2);
    x(k) = x(k-1) + (3*T)./(2)*fx(k-1) - (T/2)*fx(k-2);
    y(k) = y(k-1) + (3*T)./(2)*fy(k-1) - (T/2)*fy(k-2);
end

%PLOTTING
subplot(3,1,j)
t1 = sprintf("T = %0.2f", T);
plot(x, y)
xlabel('X')
ylabel('Y')
    title(t1)
end
```



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