ENGR 232 - Lab 4 Prelab Review (Winter 2011)

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Problem Statement

We are now given a second order system of first order linear differential equations. They are also autonomous. We would like to solve for the solution of the system and provide both the component plots (each part of the solution vs. time) and the trajectory (second component of the solution vs. first component of the solution).

Find the equilibrium point

We have the system of first order differential equations defined in the m-file, L4PL.m. Setting all derivatives equal to zero, we should get the equilibrium point of the system. The result of doing this is a set of linear equations. We can solve this by putting the system in Matrix form and solving the system of equations using a matrix inverse.

```
A = [-1 4; -4 -1]; B = [11; 35];
eqPt = A^-1*B;
```

Call to ODE45

The call to ODE45 is the same as before, except now the initial condition has 2 row elements instead of one. The outputs are t and XY whose first column is the first component of the solution and like wise.

```
tSPAN = [0 10];
XYinit = [0
          0];
[t XY] = ode45(@L4PL,tSPAN,XYinit);
```

Plotting the results

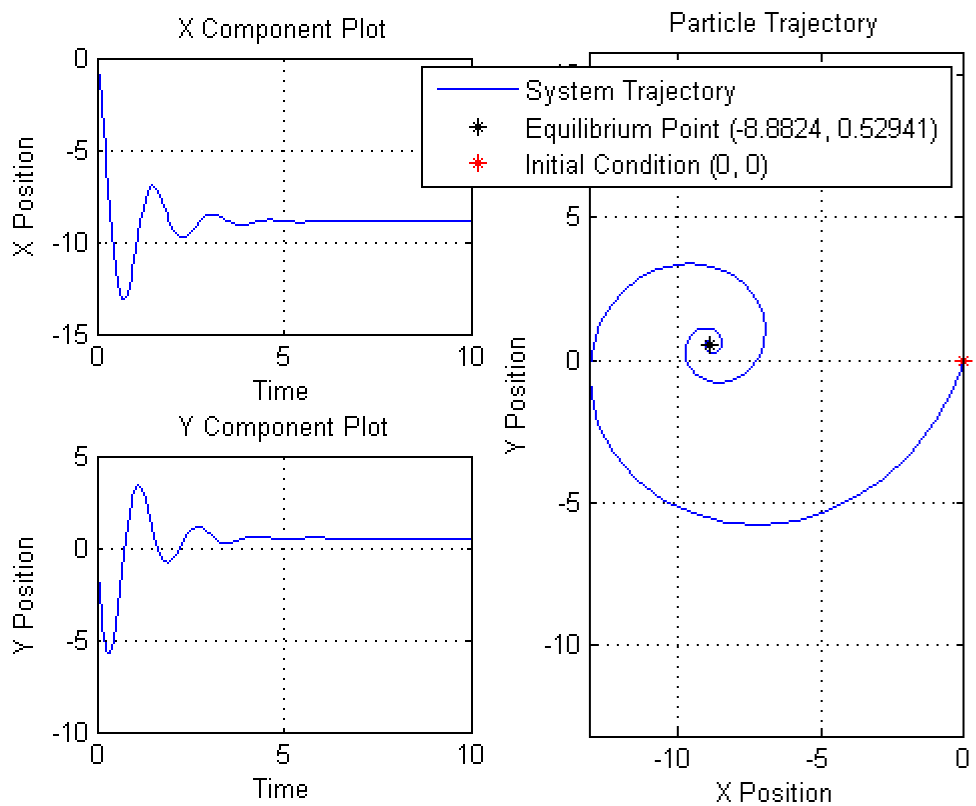
We follow the same plotting rules as set forth before with subplots. For the augmented display, view the subplot examples in MATLAB's product help. Also, pay close attention to the use of the num2str() command in the last plot.

Also notice that single coordinate pairs can be plotted with the plot command. Again, see the final plot command for more information.

```
subplot(2,2,1), plot(t,XY(:,1))
title('X Component Plot')
xlabel('Time'), ylabel('X Position'), grid on

subplot(2,2,3), plot(t,XY(:,2))
title('Y Component Plot')
xlabel('Time'), ylabel('Y Position'), grid on

subplot(2,2,[2 4]), plot(XY(:,1),XY(:,2),eqPt(1),eqPt(2),'k*',...
        XYinit(1),XYinit(2),'r*')
title('Particle Trajectory')
xlabel('X Position'), ylabel('Y Position'), grid on, axis equal
legend('System Trajectory', ['Equilibrium Point (' num2str(eqPt(1)) ...
       ', ' num2str(eqPt(2)) ')'],['Initial Condition (' ...
                                   num2str(XYinit(1)) ', '...
                                   num2str(XYinit(2)) ')'])
```



Function - L4PL

The function requirements for a general order system are shown in Lab 4.

```
type L4PL
```

```
function XYdot = L4PL(t,XY)
XYdot(1,1) = -XY(1,1) + 4*XY(2,1) - 11;
XYdot(2,1) = -4*XY(1,1) - XY(2,1) - 35;
```

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