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%% Code for interactive drawing the phase portrait to an example at the
lecture
%% it is easy to change the code for drawing  the phase portrait for an
arbitrary equation in plane
%% by changing the function for for velocity field in ode45
%% and draw another Lyapunov function or draw nullclines
clear all
t0 = 0; % starttid
tend = 200; % sluttid

L=3;
  options = odeset('RelTol',1e-7); %defining higher relative tolerance for
ode45,
  %default precision might be not enough to produce fine orbits in the phase
plane.
        xlabel('x1');
        ylabel('x2');
        axis equal % fixing equal scale along both axes
        axis([-L,L, -L, L])% fixing the sise of the picture necessary
                           % when some trajectorie might go to infinity
      hold on;%
       title('Phase plain example' );
       x1=linspace(-L,L );
       x2=linspace(-L,L );
[X1,X2]=meshgrid(x1,x2);% creating grid for drawing nullclines
                        %or level sets of Lyapunov functions
 C=0;
Z=0.5*X1.^2+0.5*X2.^2+(1/3)*X1.^3-C; % calculating alues of the Lyapunov
function on the grid
contour(X1,X2,Z,[0,0],'b','LineWidth',2);% drawing the zerolevel set C=0 of
the Lyapunov function

C=1/6;
Z=0.5*X1.^2+0.5*X2.^2+(1/3)*X1.^3-C;
contour(X1,X2,Z,[0,0],'r','LineWidth',2);% drawing level set C =1/6 of the
Lyapunov function

  plot([0,0],[0,0],'r*'); % drawing the equilibrium point in the origin.
  plot([-1,-1],[0,0],'b*'); % drawing the equilibrium point in (-1,0).

 button=1; %initiation of the condition that the left buton is pushed

while button==1;  %idetifying if the pushed button is the left button
    [i,j,button]=ginput(1) % reading coordinate of the cross point on the
screan by pushing left button.
        [~, y] = ode45(@(t,y)[y(2);-y(1)-y(1).^2-y(2)], [t0 tend], [i;
j],options); % start point (i,j)

        if button==1 plot(y(:,1),y(:,2), 'b');   % drawing all orbits except
the last one

        else plot(y(:,1),y(:,2), 'r','LineWidth',3);  % drawing the last
orbit
        end
end
hold off
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