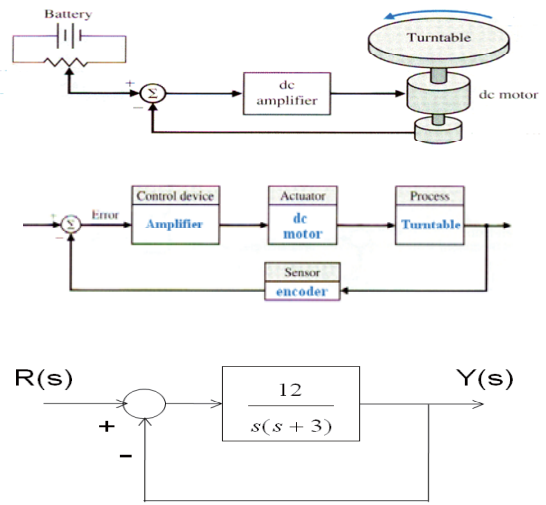
簡易動畫系統模擬

電機系 鄭智湧

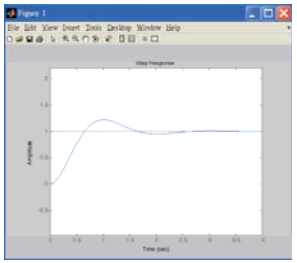
馬達位置控制



馬達模擬

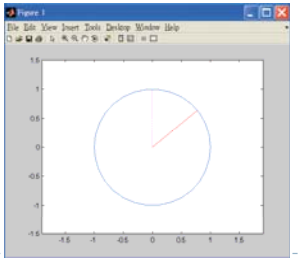
動態響應曲線

```
Y=step([12],[1 3 12]);
```



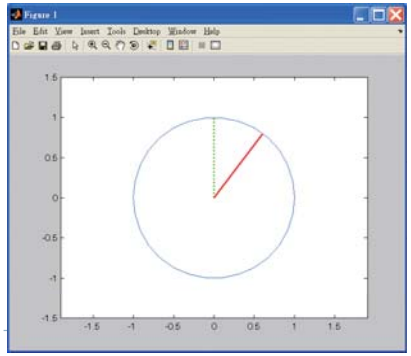
動畫模擬

```
Y=step([12],[1 3 12]);
MV=motor_mv(Y);
```



```
function MV=motor_mv(Y)

N=max(size(Y));
for i=1:N;
  %% Draw a circle
     j=0:30; P=cos(2*pi/30*j);Q=sin(2*pi/30*j);
     plot(P,Q,'b'); axis([-1.5 1.5 -1.5 1.5]); axis('equal'); hold on;
  %% Draw desired target angle position
     x=[0 0];y=[0 sin(pi/2)];
     plot(x,y,'g:','LineWidth',2);
  %% Draw motor angle position
     x=[0 cos(pi/2*Y(i))];y=[0 sin(pi/2*Y(i))];
     plot(x,y,'r', 'LineWidth',2);
     MV(:,i)=getframe; hold off;
end
```



How to simulate an ODE system?

ODE23 Solve non-stiff differential equations, low order method.
[T,Y] = ODE23(ODEFUN,TSPAN,Y0)
with time span TSPAN = [T0 TFINAL]
and with initial conditions Y0.

Van der Pol oscillator $\ddot{x} - (1 - x^2)\dot{x} + x = 0$

State space model

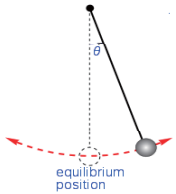
$$\begin{cases} x_1 = x \\ x_2 = \dot{x} \end{cases} \Rightarrow \begin{cases} \dot{x}_1 = x_2 \\ \dot{x}_2 = (1 - x_1^2)x_2 - x_1 \end{cases}$$

```
[t,x]=ode23(@vdp1,[0 20],[2 0]);
plot(t,x(:,1)); %plot(x(:,1),x(:,2))
```

vdp1.m

```
function dxdt = vdp1(t,x)
dxdt = [x(2);
        (1-x(1)^2)*x(2)-x(1)];
```

Practice



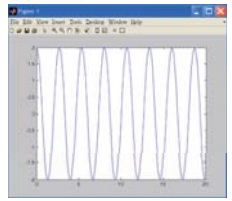
$$-mgsin\theta \ \ (-b\dot{\theta}) = ml\ddot{\theta}$$

$$\begin{cases} x_1 = \theta \\ x_2 = \dot{\theta} \end{cases} \Rightarrow \begin{cases} \dot{x}_1 = x_2 \\ \dot{x}_2 = -9.8\sin x_1 \ (-0.5x_2) \end{cases}$$

with $m = 1;\ l = 1;\ g = 9.8;\ b = 0.5;$

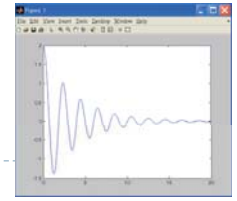
```
>> [t,x]=ode23(@pen1,[0 20],[1 0]);
>> plot(t,x(:,1));

function dxdt = pen1(t,x)
dxdt = [x(2); -9.8*sin(x(1))];
```



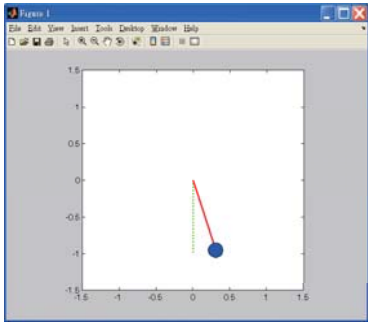
```
>> [t,x]=ode23(@pen2,[0 20],[1 0]);
>> plot(t,x(:,1));

function dxdt = pen2(t,x)
dxdt = [x(2); -9.8*sin(x(1))-0.5*x(2)];
```



function pend_draw(X)

```
N=max(size(X));
for i=1:N;
  %% Draw desired target angle position
     x=[0 0];y=[0 -1];
     plot(x,y,'g:','LineWidth',2);
     axis('equal'); axis([-1.5 1.5 -1.5 1.5]); hold on;
  %% Draw stick
     x=[0 sin(X(i,1))];y=[0 -cos(X(i,1))];
     plot(x,y,'r', 'LineWidth',2);
  %% Draw a circle
     j=0:30; P=x(2)+0.1*cos(2*pi/30*j);Q=y(2)+0.1*sin(2*pi/30*j);
     fill(P,Q,'b');
     MV(:,i)=getframe; hold off;
end
```



Check animation

```
>> [t,x]=ode23(@pen1,[0 20],[1 0]);
>> pend_draw(x);
```

```
>> [t,x]=ode23(@pen2,[0 20],[1 0]);
>> pend_draw(x);
```