

線性系統作業二說明

Location: MD231

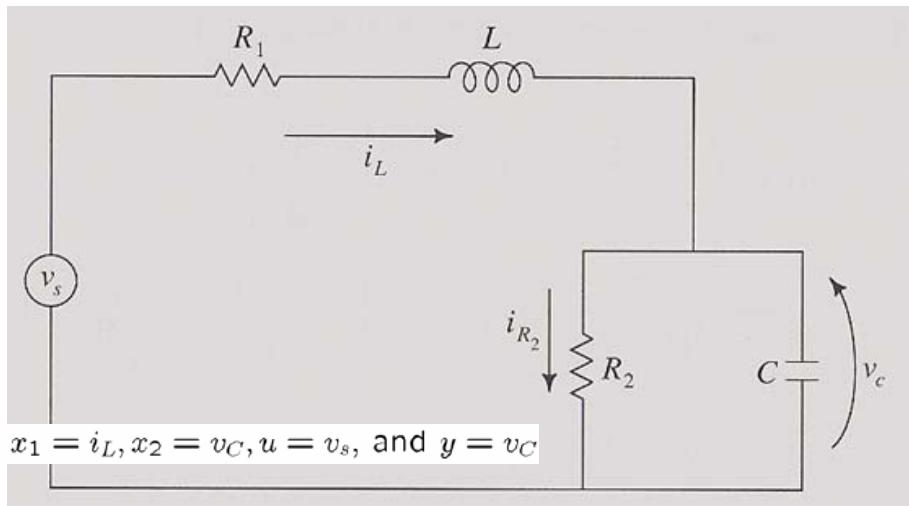
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作業二檔案

- From
<http://cc.ee.ntu.edu.tw/~fengli/Teaching/LinearSystems/>
- HW2_1b.m
- HW2_1b_plant.m
- HW2_1b_solver.m
- HW2_2.m

HW2.1 (1)



$$\Rightarrow A = \begin{bmatrix} -\frac{R_1}{L} & -\frac{1}{L} \\ \frac{1}{C} & -\frac{1}{CR_2} \end{bmatrix}, \quad B = \begin{bmatrix} \frac{1}{L} \\ 0 \end{bmatrix}, \quad C = [0 \ 1], \quad D = 0$$

$R_1 = 2, R_2 = 10, L = 0.5, C = 1.$

HW2.1 (2)

- 1a Find the analytical solution of the system, that is, $x(t) = ?$ → 寫出 $x(t)$ 的解析解
- 1b Given the initial conditions $x(0) = [0, 0]^\top$, and the input, $u(t) = 1$, find the numerical solution of the system by using (1) direct computation, (2) the STEP function, (3) the ODE45 function. Show the result by plotting the values of state versus time and discuss what are shown in the plots. → 用三種方法算出 x 數值
- 1c Given the different initial conditions $x(0) = [1, -1]^\top$, and the input, $u(t) = a * \sin(b * t)$, find the numerical solution of the system by using (1) direct computation, (2) the ODE45 function. You need to try different values of a and b . Show the result by plotting the values of state versus time and discuss the result shown in the plots. → 同上，但改變了 Initial condition 及 Input

HW2_1b.m Code (1)

```
6 - close all; clear all;
7
8 %syms R1 R2 L C s t tau
9
10 % 1a
11
12 - R1 = 2;
13 - R2 = 10;
14 - L = 0.5;
15 - C = 1;
16
17 - Ap = [ -R1/L -1/L;
18     1/C -1/(C*R2)];
19
20 - Bp = [ 1/L ; 0 ];
21 - Cp = [ 0 1 ];
22 - Dp = 0;
23
24 - eig(Ap) 0          ➔ Find eigenvalues of Ap (沒分號，答案會印出來)
25
26
27 - Sysp = ss(Ap,Bp,Cp,Dp); ➔ Sysp is the State Space of ABCD
28
29
30 - [Nump, Demp] = ss2tf( Ap, Bp, Cp, Dp ); ➔ Nump/Demp is the Transfer Function of ABCD
```

HW2_1b.m Code (2)

```
37 - syms t tau          ➔ 定義兩符號 t 及 tau
38
39 - xp0 = zeros(2,1);    ➔ Xp0 = [0 0]
40 - u = 1;
41 - %u = sin(0.5*pi*tau);
42
43 - expAp = expm( Ap * t ); ➔ 針對矩陣做計算
44
45 - zi = expAp * xp0 0    ➔ Zero Input Response
46
47 - zs = int( expm( Ap*(t-tau) ) * Bp * u, tau, 0, t ) ➔ Zero State Response
48
49 - xpt = zi + zs 0      ➔ 可使用 pretty 將其美化
50
51 - subs( xpt, t, 1 ) 0 ➔ 將 t 用 1 代入
52
53 - for i=1:101
54 -     time1(i) = (i-1)*0.1; ➔ 最後 time1 = [0 0.1 0.2 ... 10]
55 -     state1(:,i) = subs( xpt, t, time1(i) );
56 -     u1 = subs( u, tau, time1(i) );
57 -     output1(i) = Cp*state1(:,i) + Dp*u1;
58 - end
```

HW2_1b.m Code (3)

- 前幾頁是第一種方法—疊代
- 第二種方法只有一行：
[output2,time2,state2] = step(Sysp,10);
- 第三種方法請見檔案
 - HW2_1b_plant.m
 - HW2_1b_solver.m

HW2_2b_plant.m Code

```
8 function dx = HW2_1b_plant(t,x)    ➔  一個微分函數，包含名稱、輸入、輸出
9
10 % system parameters
11 - R1 = 2;
12 - R2 = 10;
13 - L = 0.5;
14 - C = 1;
15
16 - Ap = [ -R1/L -1/L;
17      1/C -1/(C*R2)];
18
19 - Bp = [ 1/L ; 0 ];
20 - Cp = [ 0 1 ];
21 - Dp = 0;
22
23
24 % model
25
26 - dx = zeros(2,1);          ➔  dx = [0 0]，主要是宣告矩陣大小
27 - u = 1;
28 - %u = sin(0.5*pi*t);
29
30 - dx = Ap * x + Bp * u;    ➔  最後的dx表示式
```

HW2_2b_solver.m Code

```
9 - clear all;
10
11 - xinit = zeros(2,1);      ➔ Initial condition xint = [0 0]
12
13 - [ time3, state3 ] = ode45( @HW2_1b_plant, [ 0 10 ], xinit ); ➔ Ode45使用方法
14
15 - figure(31)
16 - subplot(211)
17 - plot( time3, state3 );
18 - xlabel('time'); ylabel('state');
```

Input1: @plant檔名
Input2: 積分時間的範圍
Input3: state的初始值

Thank You
可以醒來了~