# Chapter2

31202008881 Bao Ze an

today

## 2.1

What we know is the linear system must obey the superposition property.
The input-output description in Fig2.1(a) is :$y = a * u$.
Here $a$ is a constant .It is eay to find the system(a) is a linear system.
The input-output decription in Fig2.1(b) is:$y = a * u + b$.
Here $a$ and $b$ are all constants.Thstify whether the system has the property of additivity Let:

$$y_1 = a * u_1 + b.$$

$$y_2 = a * u_2 + b.$$

then:

$$(y_1 + y_2) = a * (u_1 + u_2) + 2 * b$$

so it does not satisfy the property of additivity.therefore,it is a nonlinear system.
It is obviously the system in the Fig2.1(c) is a nonliear system.
When system(b) introduce $y - y_0$ as the new output,system(c) can be the linear system.

section*2.2 Because $g(t)$ is not zero,when $t \leq 0$,so the ideal lowpass filter is not causual and the ideal filter can't build in the real world.

## 2.3

It is easy to find the system is a linear system.
Testify whether the system is time-invariable:
Definine the initial time of input $t_0$,system input is $u(t)$,$t \geq t_0$,so it decides the output $y(t)$,$t \geq t_0$

$$y(t) = \begin{cases} u(t), & for \quad t_0 \leq t \leq \alpha \\ 0, & for \quad t \geq \alpha. \end{cases}$$

Shift the initial time to $t_0 + T$.Let $t_0 + T > \alpha$,and shift the input to $u(t - T)$,$t \geq t_0 + T$.
The system output is $y'(t) = 0$.Suppose that $u(t)$ is not 0,$y'(t)$ is not equal to $y(t - T)$.
So,the system is time-invaring.
For any time t,the system output y(t) is decided by the current input u(t) exclusively.
So,it is a causual time.

## 2.4

Let:$y = Hu$ Because of causual property:

$$y_{(-\infty,\alpha)} = Hu_{(-\infty,+\infty)} = Hu_{(-\infty,\alpha)} = HP_\alpha u_{(-\infty,+\infty)}$$

Thus we have:

$$P_\alpha y = P_\alpha Hu = P_\alpha HP_\alpha u$$

Because$(P_\alpha Hu)(t) = 0$for $t \geq \alpha$,but $(HP_\alpha u)(t)$can be nonzero for $t \geq \alpha$ Thus $P_\alpha Hu \neq HP_\alpha u$