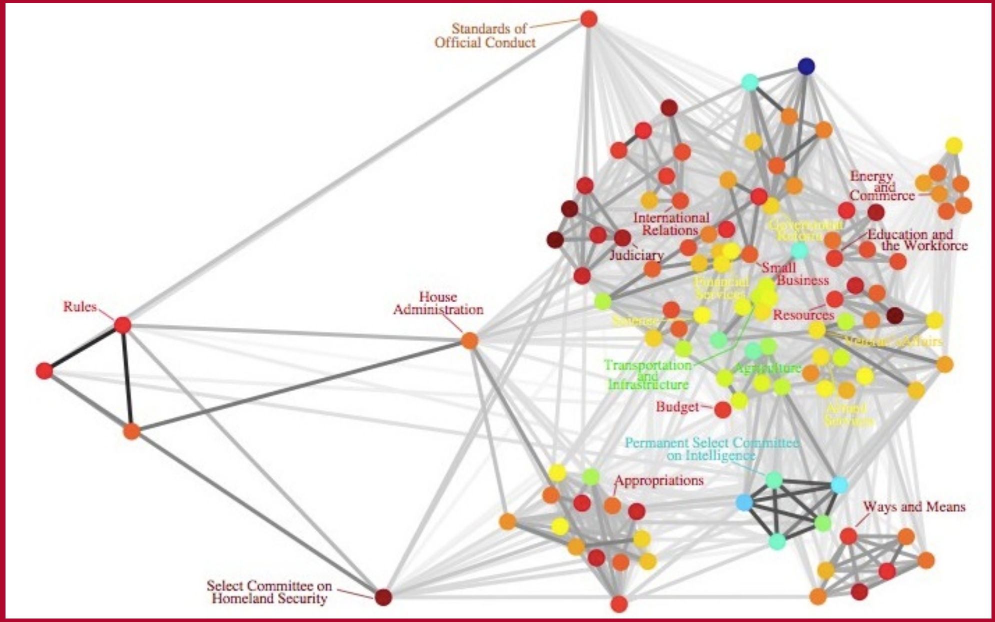
Automatic Control Theory

Chapter 2



Fan zichuan
School of Computer and Information Science
Southwest University

Review

- **Transfer function**
- **Laplace Transform**
- **Block Diagram reduction**

what is next

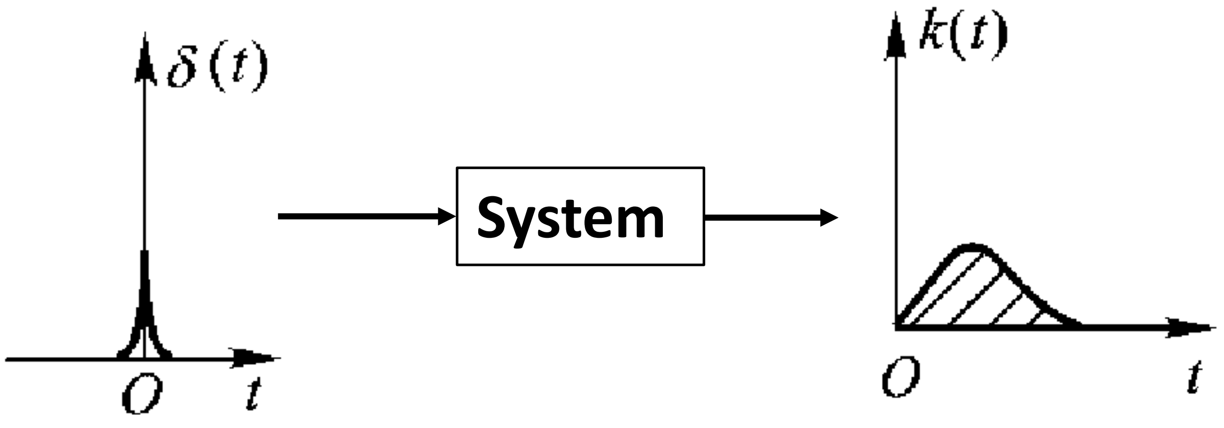
➢ **Unit impulse response function**

➢ **Different types of Transfer function**

Unit impulse response function

unit impulse function $\delta(t)$

unit impulse response $k(t)$



$$L[\delta(t)]=1,\ L[k(t)]=K(s)$$

Transfer function $\Phi(s)=\dfrac{K(s)}{1}=K(s)$

Unit impulse response function

Arbitrary function input $r(t)$ → **System** → ouput $c(t)$

$$C(s) = \Phi(s) \cdot R(s) = K(s) \cdot R(s)$$

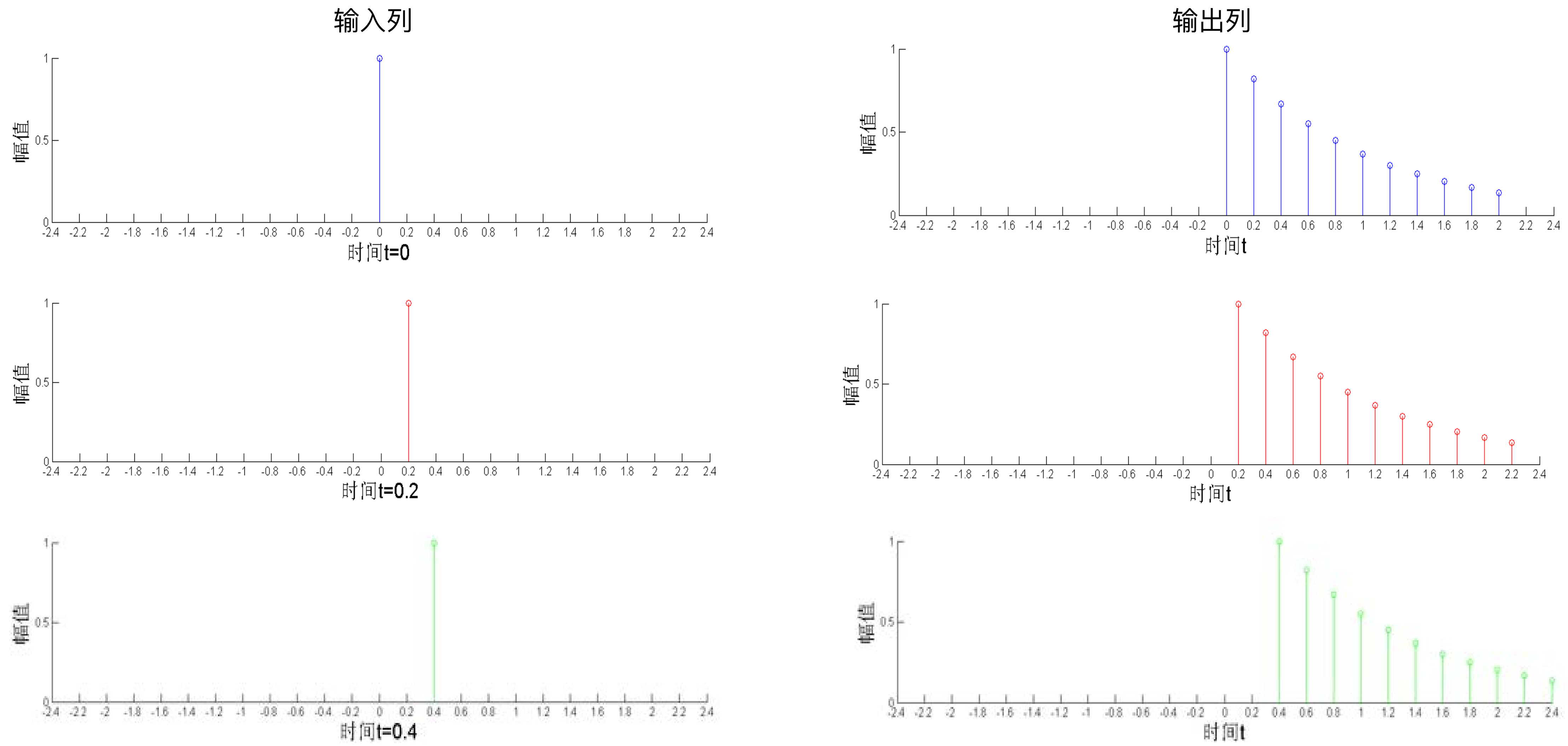
$$c(t) = L^{-1}[K(s) \cdot R(s)]$$

卷积！时域上的卷积等效复域的点积

$$= \int_0^t r(\tau) k(t-\tau) \mathrm{d}\tau$$

Convolution function

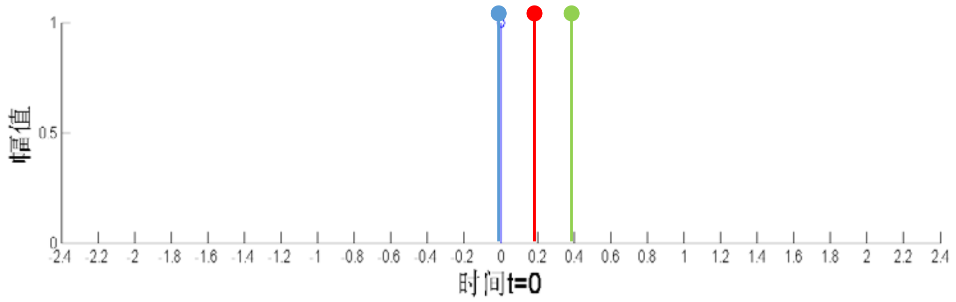
Convolution function



Convolution function

$$\int_0^t r(\tau)k(t-\tau)\mathrm{d}\tau$$

时间的反转 越先进去作用靠前 距离t反应最微弱
越晚出去距离t越及时
r（t）像权重
卷积：将输出分段后多个输入叠加



Total input

如果我想要很多未知输入得到很多未知输出
我只需要得到一次脉冲函数和脉冲响应函数
用该脉冲函数构成我想要的输入，卷积就可以得到输出
非常牛!

图1

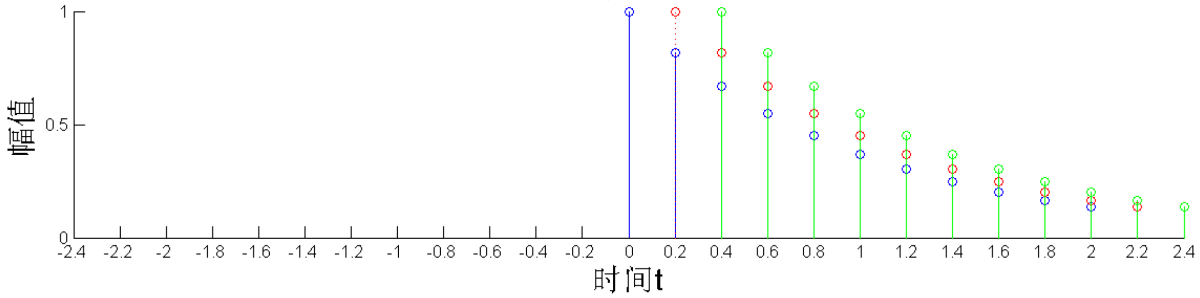
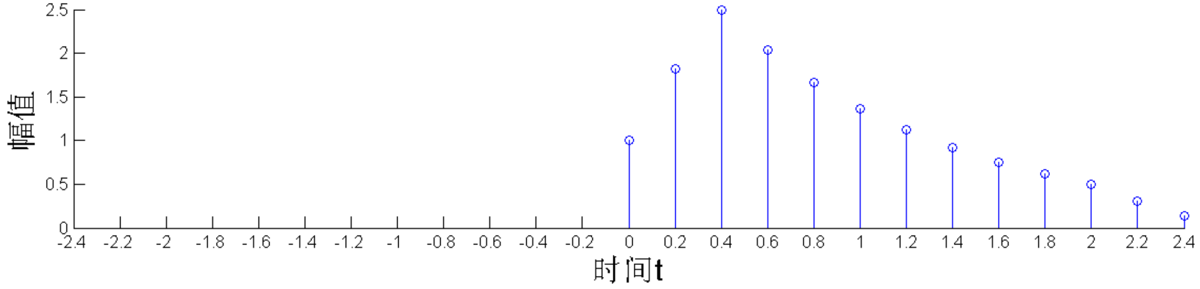


图2



Total output

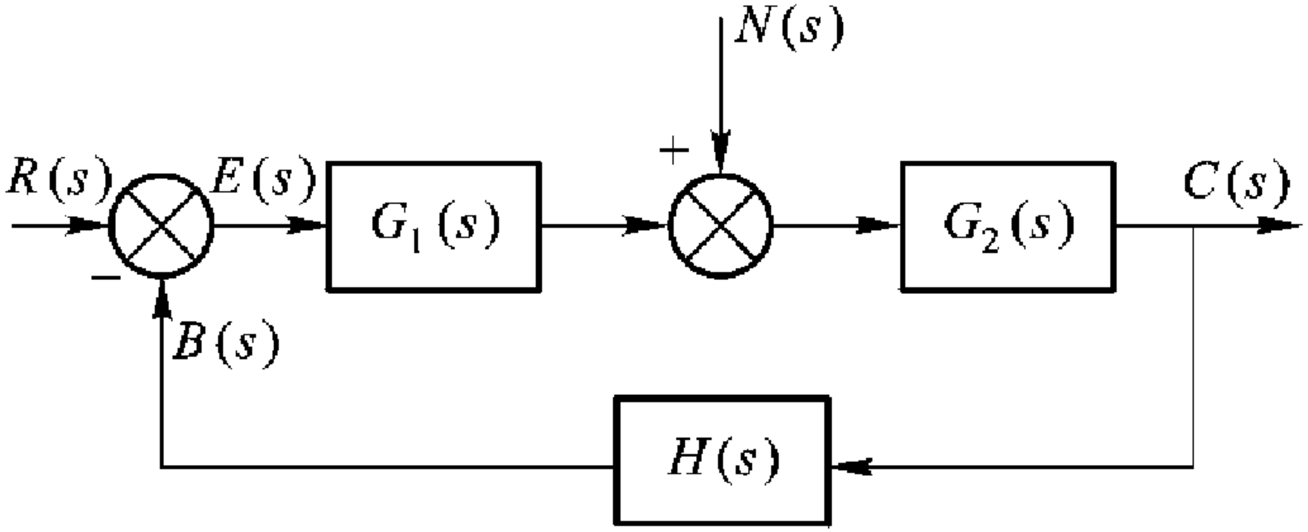
Different types of Transfer function

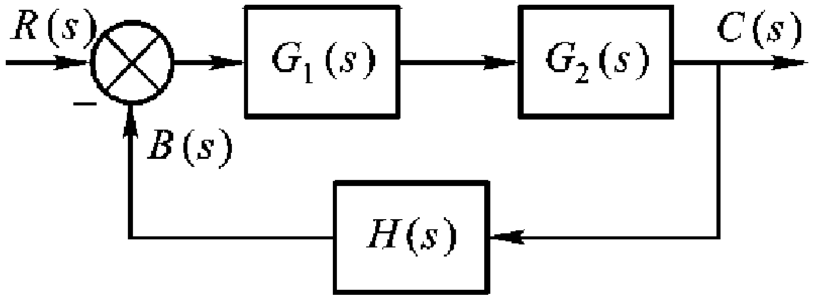
Transfer function:

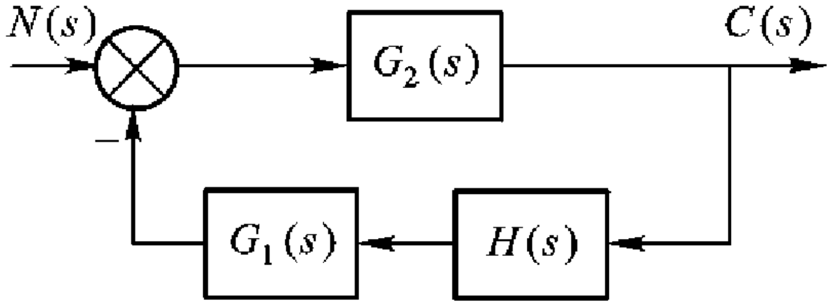
The **ratio** of the Laplace transform of the output variable to the Laplace transform of the input variable, with all initial conditions assumed to be zero.

Different definitions: input variable output variable

Different types of Transfer function





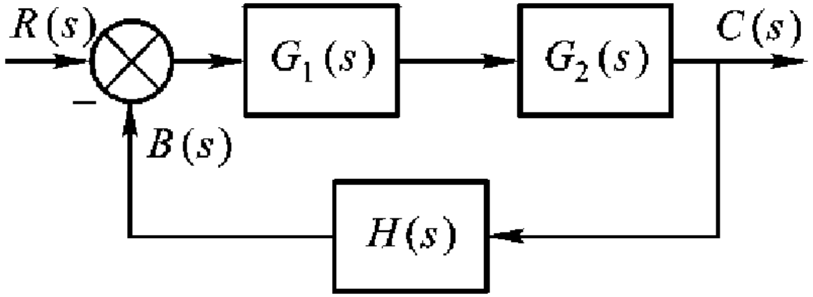


Different definitions: input variable output variable

Different types of Transfer function

(1) input variable ： R(s)

n(t)=0 !

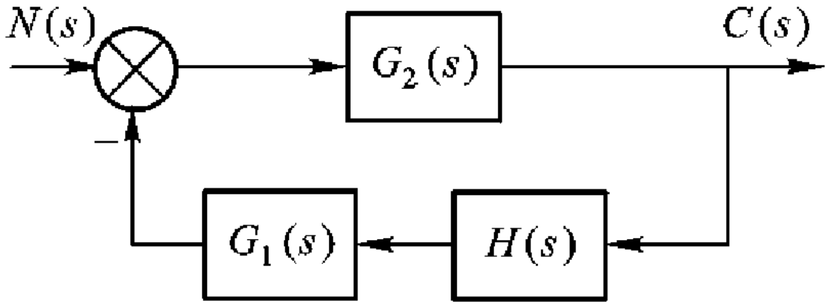


$$\Phi(s)=\frac{C(s)}{R(s)}=\frac{G_1(s)G_2(s)}{1+G_1(s)G_2(s)H(s)}$$

$$C(s)=\Phi(s)R(s)=\frac{G_1(s)G_2(s)}{1+G_1(s)G_2(s)H(s)}R(s)$$

(2) output variable ： N(s)

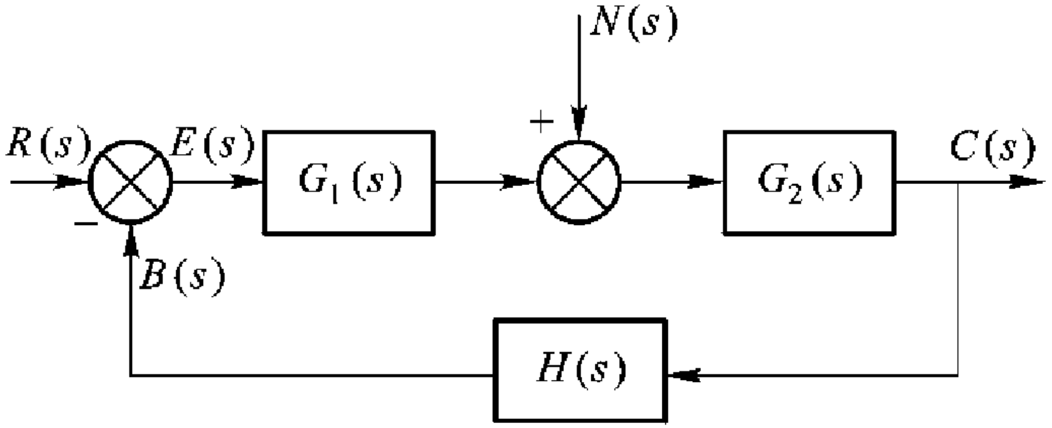
r(t)=0 !



$$\Phi_n(s)=\frac{C(s)}{N(s)}=\frac{G_2(s)}{1+G_1(s)G_2(s)H(s)}$$

$$C(s)=\Phi_n(s)N(s)=\frac{G_2(s)}{1+G_1(s)G_2(s)H(s)}N(s)$$

Different types of Transfer function



$$C_{\Sigma}(s)=\frac{G_1(s)G_2(s)}{1+G_1(s)G_2(s)H(s)}R(s)+\frac{G_2(s)}{1+G_1(s)G_2(s)H(s)}N(s)$$

More details in Chapter 3 The performance of feedback control systems

Different types of Transfer function

核心

- **Unit impulse response function**
- **Convolution function**

续

- ***Chapter 3 The performance of feedback control systems***