



石家莊鐵道大學  
SHIJIAZHUANG TIEDAO UNIVERSITY

网络精品课程

自动控制原理

采样控制系统分析

闭环脉冲传递函数

主讲：郑海青

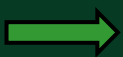


## 闭环系统脉冲传递函数

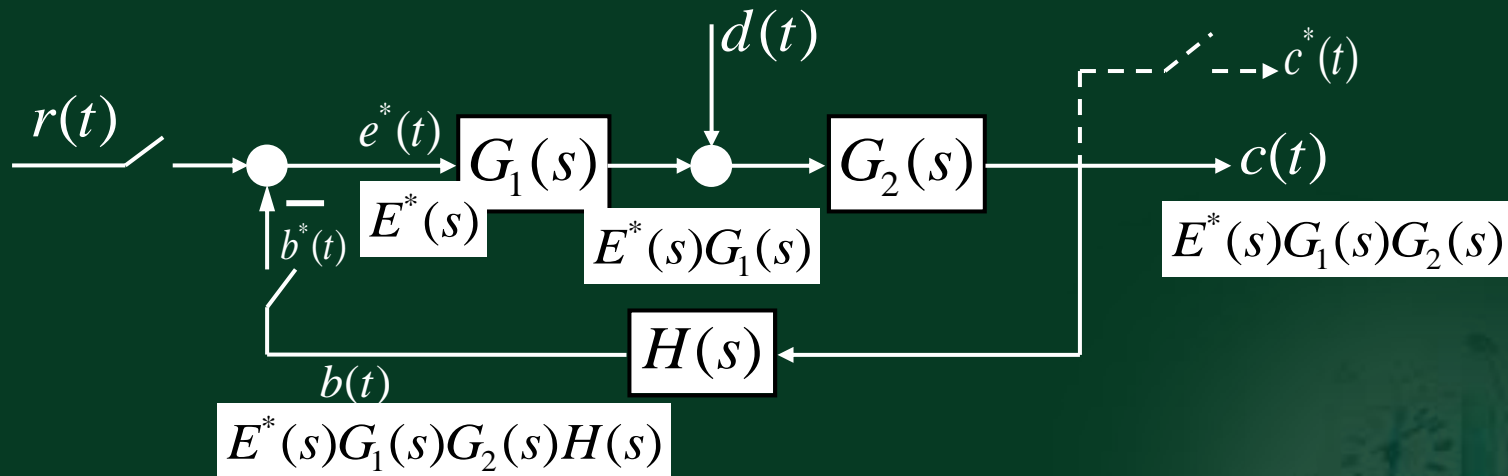
在采样系统中，采样开关在系统中所处位置不同



系统结构不同

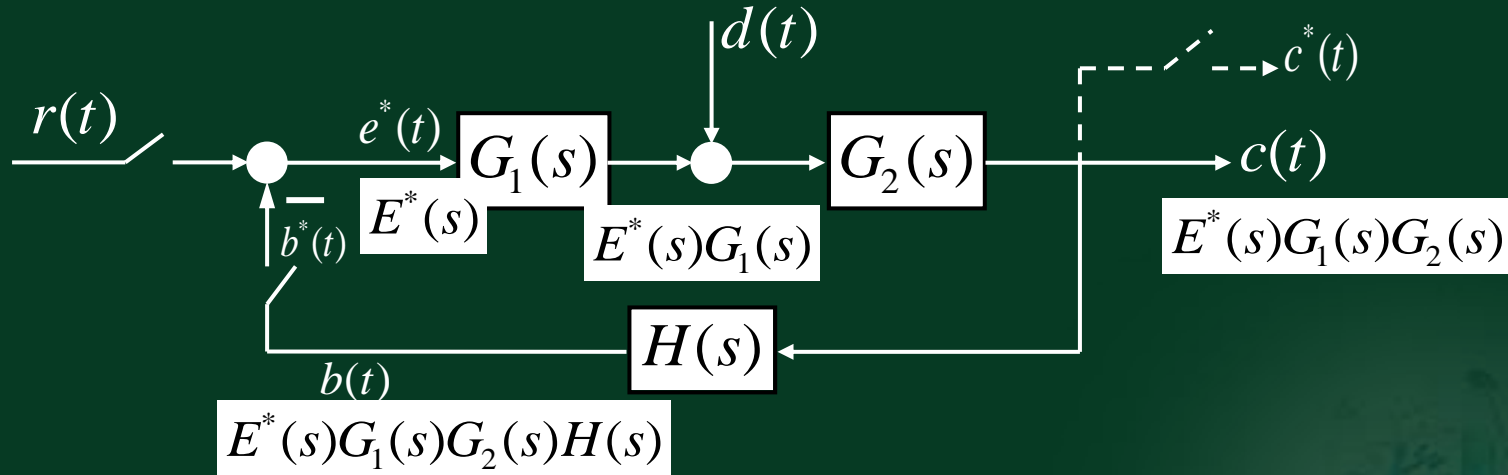


闭环系统脉冲传递函数不同



## 1. 闭环系统的开环脉冲传递函数

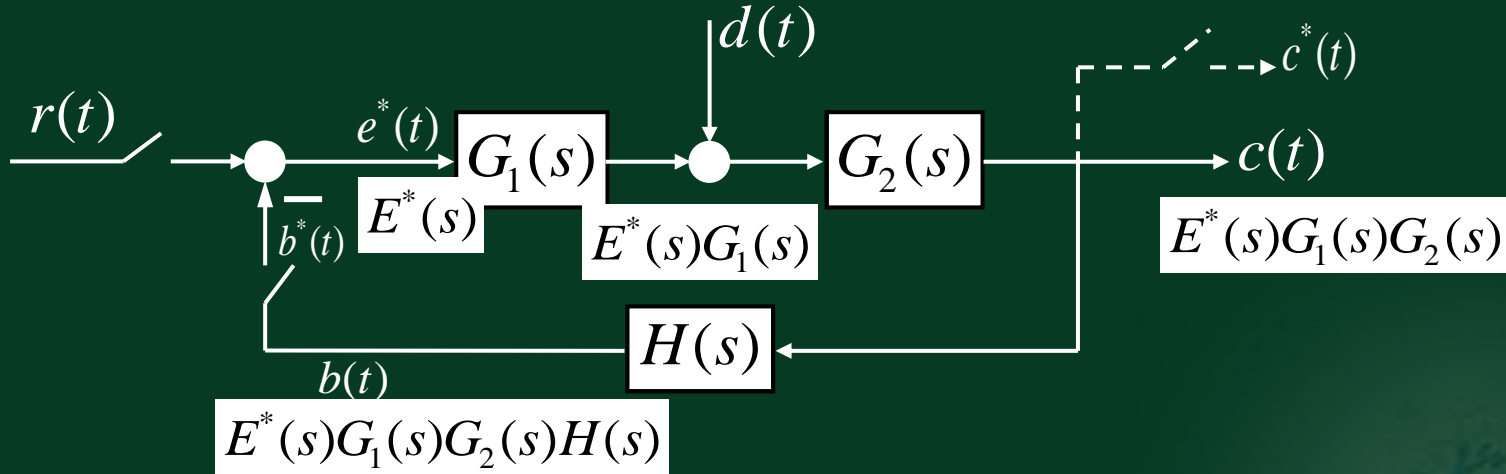
断开主反馈通路，从 $e^*(t)$ 到 $b^*(t)$ 之间的脉冲传递函数



$$B(s) = G_1(s)G_2(s)H(s)E^*(s)$$

$$\Rightarrow B^*(s) = [G_1(s)G_2(s)H(s)E^*(s)]^* = [G_1(s)G_2(s)H(s)]^* E^*(s)$$

$$G(z) = B(z) / E(z) = G_1G_2H(z)$$



2.  $r^*(t)$ 到 $c^*(t)$ 之间的闭环脉冲传递函数 $\Phi(z)$

$$\text{令 } d(t) = 0 \quad C(s) = E^*(s)G_1(s)G_2(s) \Rightarrow C^*(s) = E^*(s)G_1G_2^*(s)$$

$$B(s) = E^*(s)G_1(s)G_2(s)H(s) \Rightarrow B^*(s) = E^*(s)G_1G_2H^*(s)$$



$$E^*(s) = R^*(s) - B^*(s) \Rightarrow E^*(s) = R^*(s) - E^*(s)G_1G_2H^*(s)$$

$$\Rightarrow E^*(s) = \frac{R^*(s)}{1 + G_1G_2H^*(s)}$$

$$\Rightarrow \frac{C^*(s)}{R^*(s)} = \frac{G_1G_2^*(s)}{1 + G_1G_2H^*(s)}$$

$$\Phi(z) = \frac{C(z)}{R(z)} = \frac{G_1G_2(z)}{1 + G_1G_2H(z)}$$



### 3. $r^*(t)$ 到 $e^*(t)$ 之间的误差脉冲传递函数

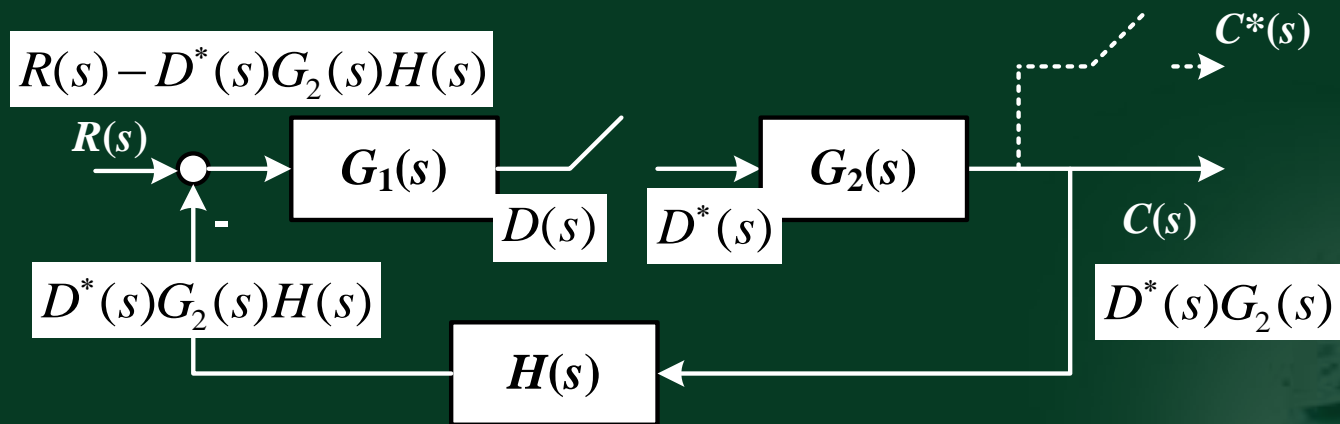
$$\Phi_{er}(z) = \frac{E(z)}{R(z)} = \frac{1}{1 + G_1 G_2 H(z)}$$

### 4. 离散系统的闭环特征方程

$$1 + G_1 G_2 H(z) = 0$$



如下图的闭环采样系统，求 $C(z)$



解：  $D(s) = [R(s) - D^*(s)G_2(s)H(s)]G_1(s)$

$$\Rightarrow D^*(s) = RG_1^*(s) - D^*(s)G_2G_1H^*(s)$$





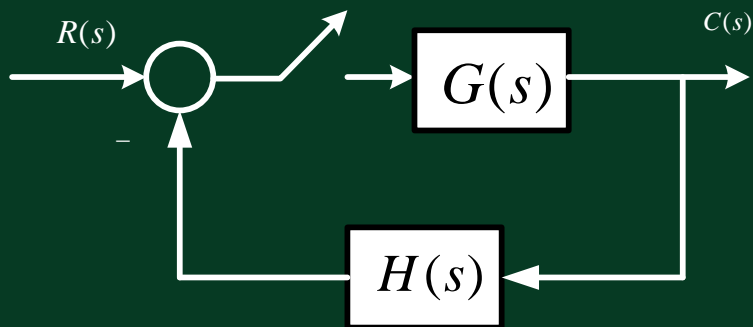
$$\Rightarrow D^*(s) = \frac{RG_1^*(s)}{1 + G_2G_1H^*(s)}$$

$$C(s) = D^*(s)G_2(s) \Rightarrow C^*(s) = D^*(s)G_2^*(s) = \frac{G_2^*(s)RG_1^*(s)}{1 + G_2G_1H^*(s)}$$

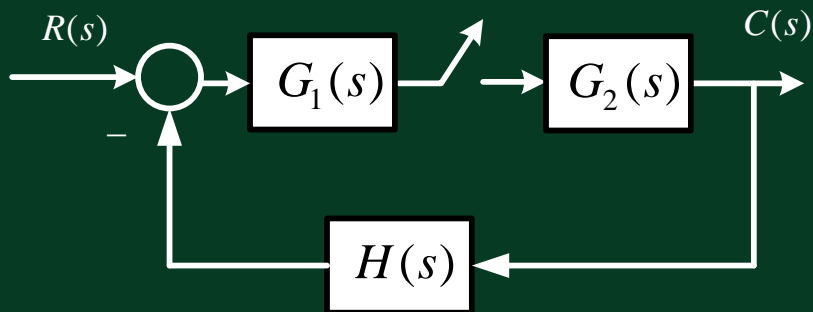
$$C(z) = \frac{G_2(z)RG_1(z)}{1 + G_2G_1H(z)}$$



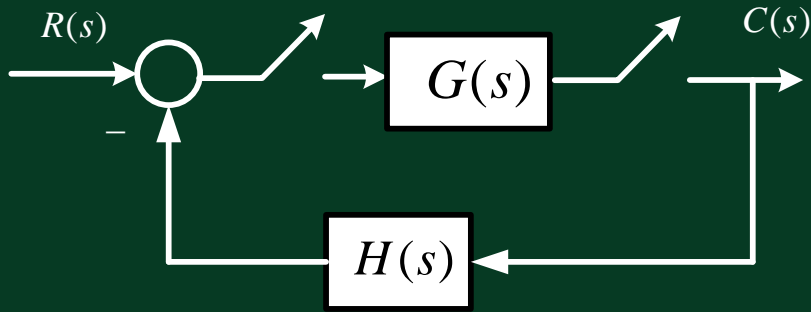
## 典型闭环离散系统及输出z变换函数



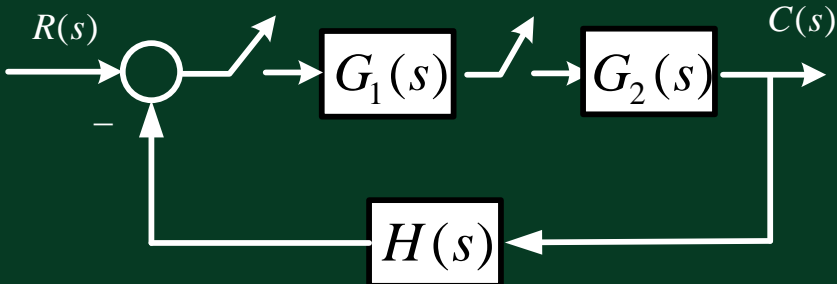
$$C(z) = \frac{G(z)R(z)}{1 + GH(z)}$$



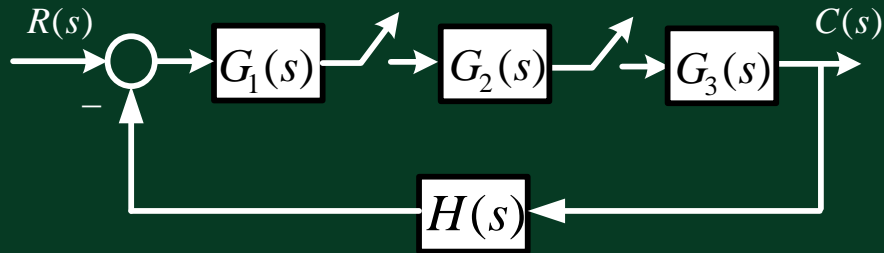
$$C(z) = \frac{RG_1(z)G_2(z)}{1 + G_2HG_1(z)}$$



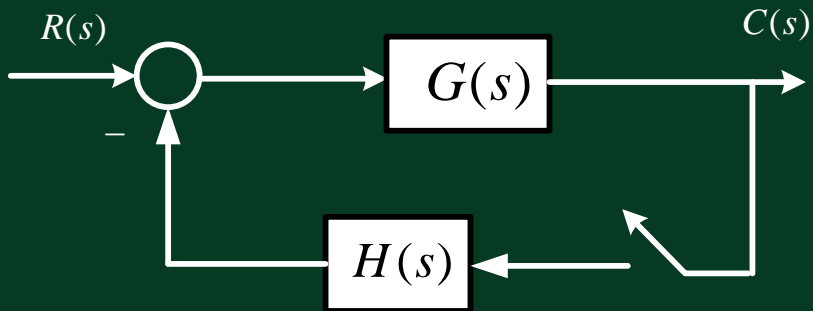
$$C(z) = \frac{G(z)R(z)}{1 + G(z)H(z)}$$



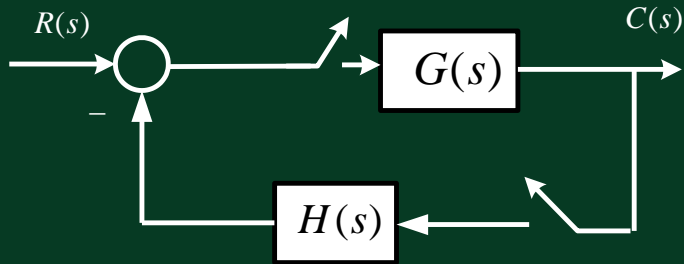
$$C(z) = \frac{G_1(z)G_2(z)R(z)}{1 + G_1(z)G_2H(z)}$$



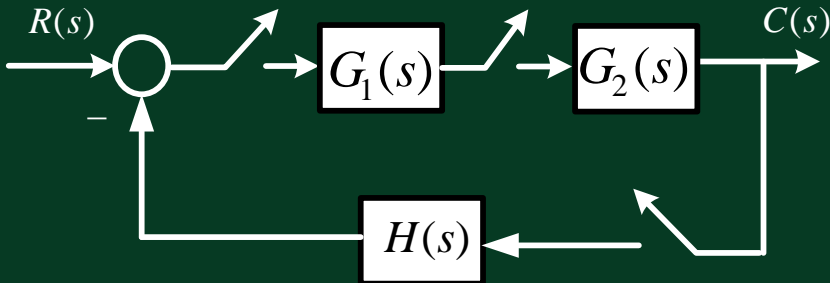
$$C(z) = \frac{RG_1(z)G_2(z)G_3(z)}{1 + G_2(z)G_1G_3H(z)}$$



$$C(z) = \frac{RG(z)}{1 + HG(z)}$$



$$C(z) = \frac{R(z)G(z)}{1 + G(z)H(z)}$$



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



石家莊鐵道大學  
SHIJIAZHUANG TIEDAO UNIVERSITY

网络精品课程

谢谢