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国家级十一(二)五规划教材/ 教育部自动化专业教学指导委员会牵头规划系列教材

控制系统仿真与CAD

# 第六章 非线性系统的建模与仿真

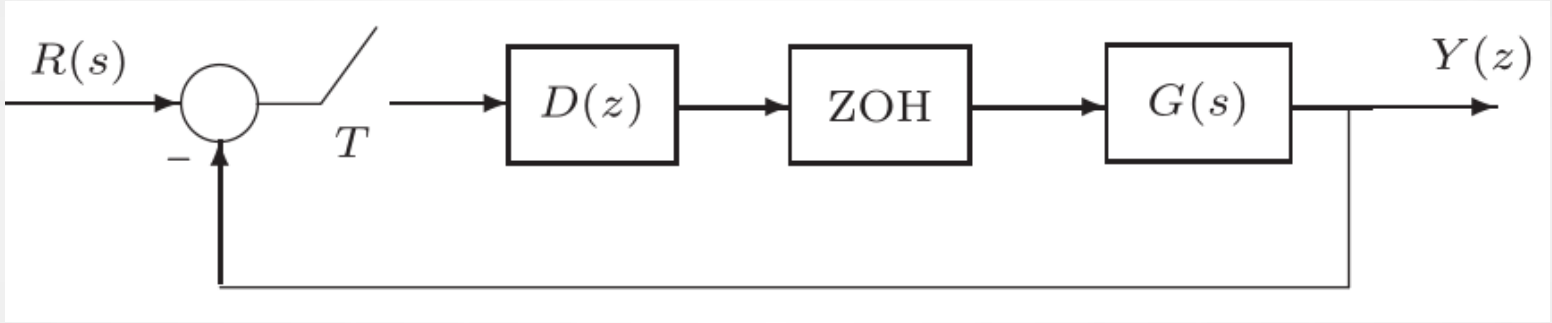
## 控制系统的Simulink建模举例（中）

Simulink Modeling Examples of Control Systems (II)


主讲：薛定宇教授

# 例6-5 计算机控制系统仿真

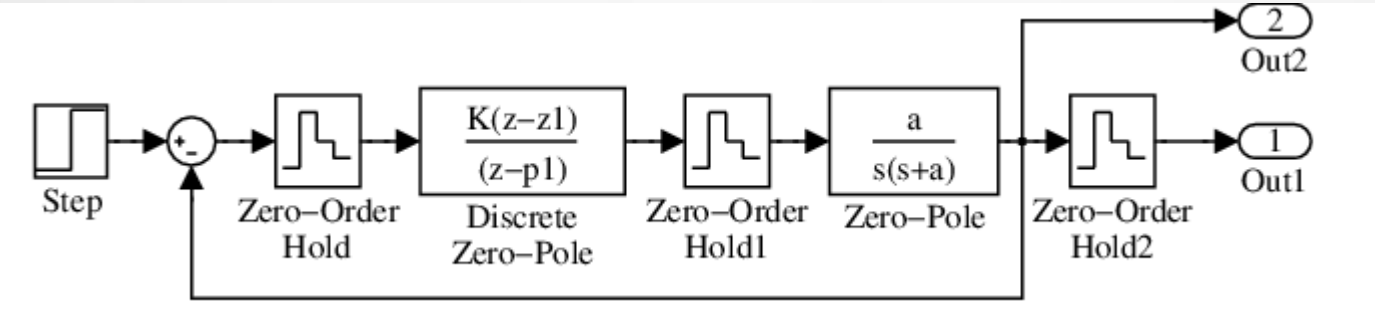
- 计算机控制系统




$$G(s)=\frac{a}{s(s+1)},\quad D(z)=\frac{1-\mathrm{e}^{-T}}{1-\mathrm{e}^{-0.1T}}\frac{z-\mathrm{e}^{-0.1T}}{z-\mathrm{e}^{-T}}$$

- 所需模块
  - 连续传递函数、离散传递函数、零阶保持器
  - 模型名：c6mcompc.mdl

# Simulink模型



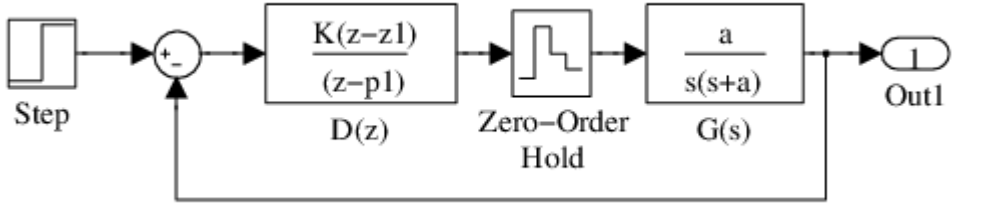

```
>> T=0.2; a=0.1; z1=exp(-0.1*T); p1=exp(-T);
   K=(1-p1)/(1-z1); [t,x,y]=sim('c6mcompc',20);
   plot(t,y(:,2)); hold on; stairs(t,y(:,1))
```

```
>> T=1; z1=exp(-0.1*T); p1=exp(-T); K=(1-p1)/(1-z1);
   [t,x,y]=sim('c6mcompc',20); plot(t,y(:,2));
   hold on; stairs(t,y(:,1))
```

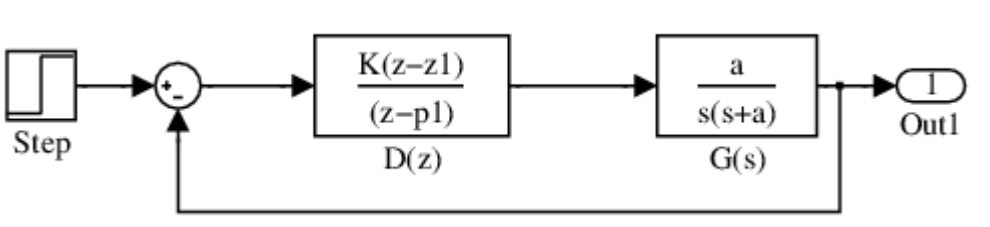
```
>> T=0.2; z1=exp(-0.1*T); p1=exp(-T); K=(1-p1)/(1-z1);
   Dz=zpk(z1,p1,K,'Ts',T); G=zpk([],[0;-a],a);
   Gz=c2d(G,T); GG=zpk(feedback(Gz*Dz,1)), step(GG)
```

# Simulink模型的化简

- Simulink模型进一步化简
  - c6mcomc1




  - c6mcomc2




- 参数的预置
  - File -> Model properties

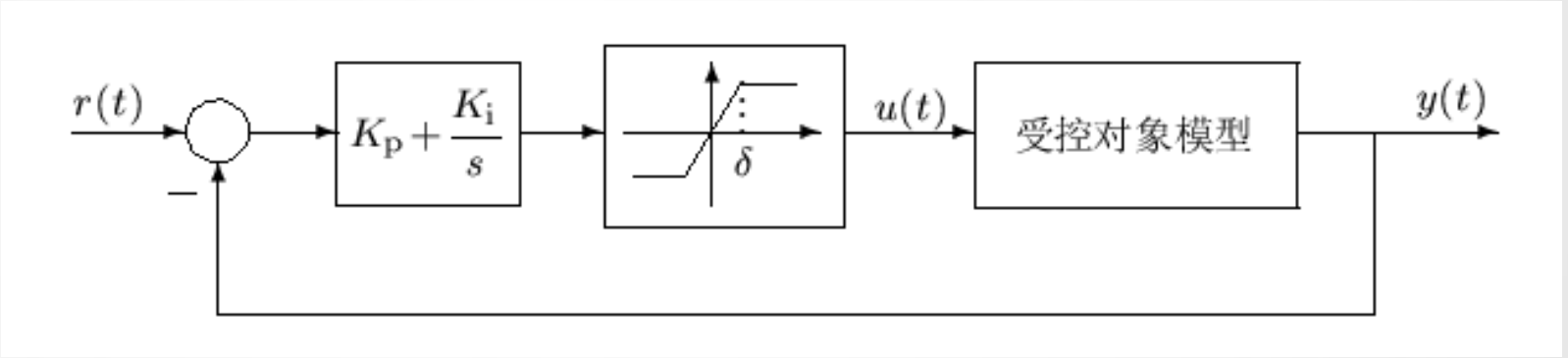
```
T=0.2; z1=exp(-0.1*T); p1=exp(-T); K=(1-p1)/(1-z1);
```

# 例6-6 时变系统仿真

- 受控对象为微分方程

$$\ddot{y}(t)+\mathrm{e}^{-0.2t}\dot{y}(t)+\mathrm{e}^{-5t}\sin(2t+6)y(t)=u(t)$$

- PI 控制器

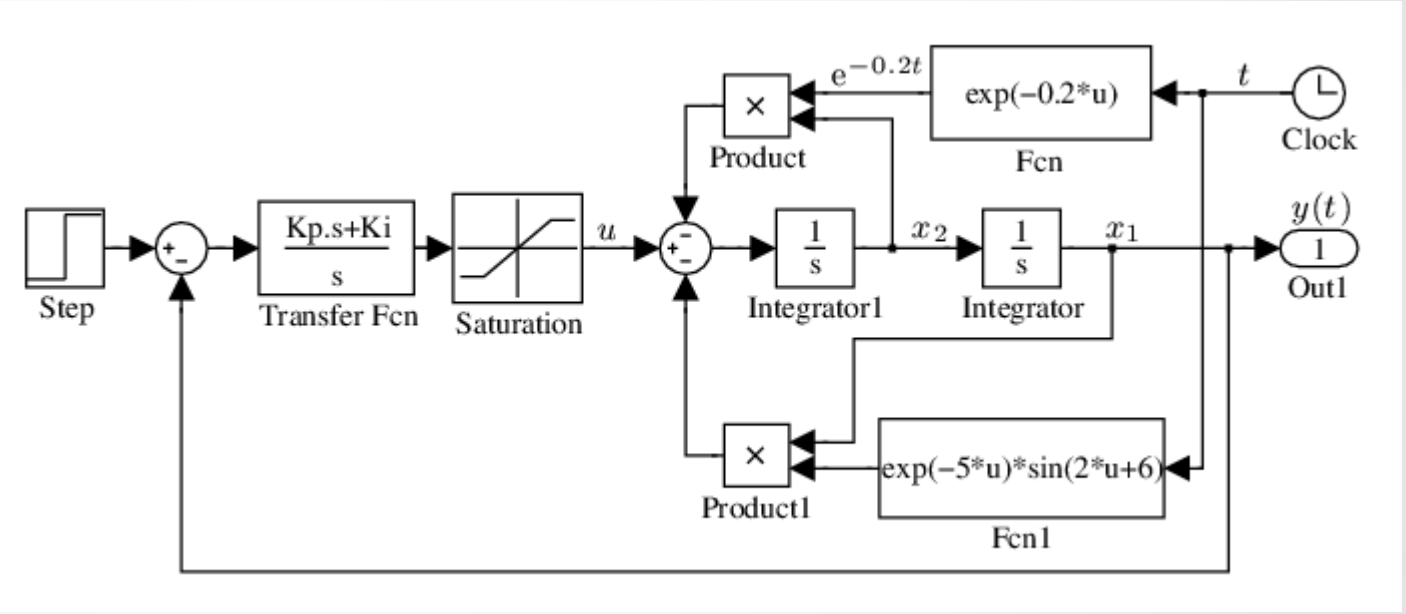



- 改写受控对象模型

$$\ddot{y}(t)=-\mathrm{e}^{-0.2t}\dot{y}(t)-\mathrm{e}^{-5t}\sin(2t+6)y(t)+u(t)$$

# Simulink建模

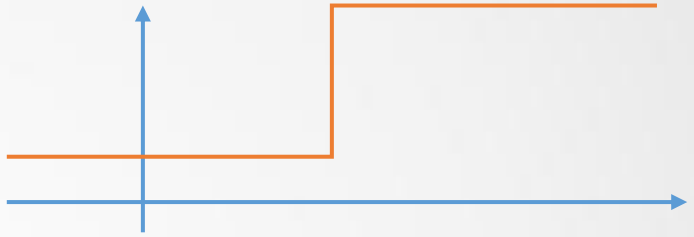
- 时变受控对象 $\ddot{y}(t) = -\mathrm{e}^{-0.2t}\dot{y}(t) - \mathrm{e}^{-5t}\sin(2t+6)y(t) + u(t)$
- 模型：c6mtimv.mdl

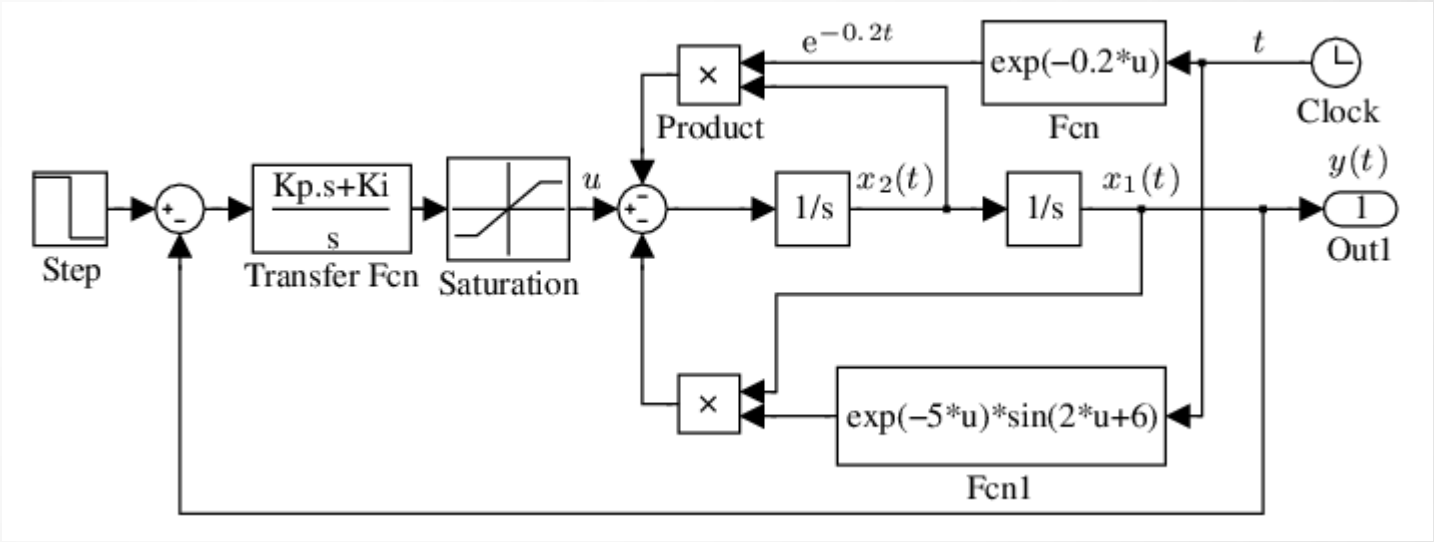



```
>> opt=simset('RelTol',1e-8); Kp=200; Ki=10;
   [t,x,y]=sim('c6mtimv',10,opt); plot(t,y)
```

# 例6-7 时变系统的脉冲响应

- 脉冲响应怎么求？
  - 没有脉冲模块
  - 脉冲模块的近似



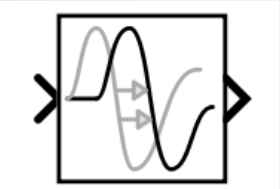


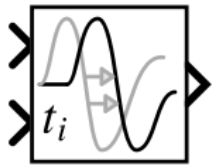

```
>> opt=simset('RelTol',1e-8); Kp=200; Ki=10; a=0.001;
   [t,x,y]=sim('c6mtimva',10,opt); plot(t,y)
```

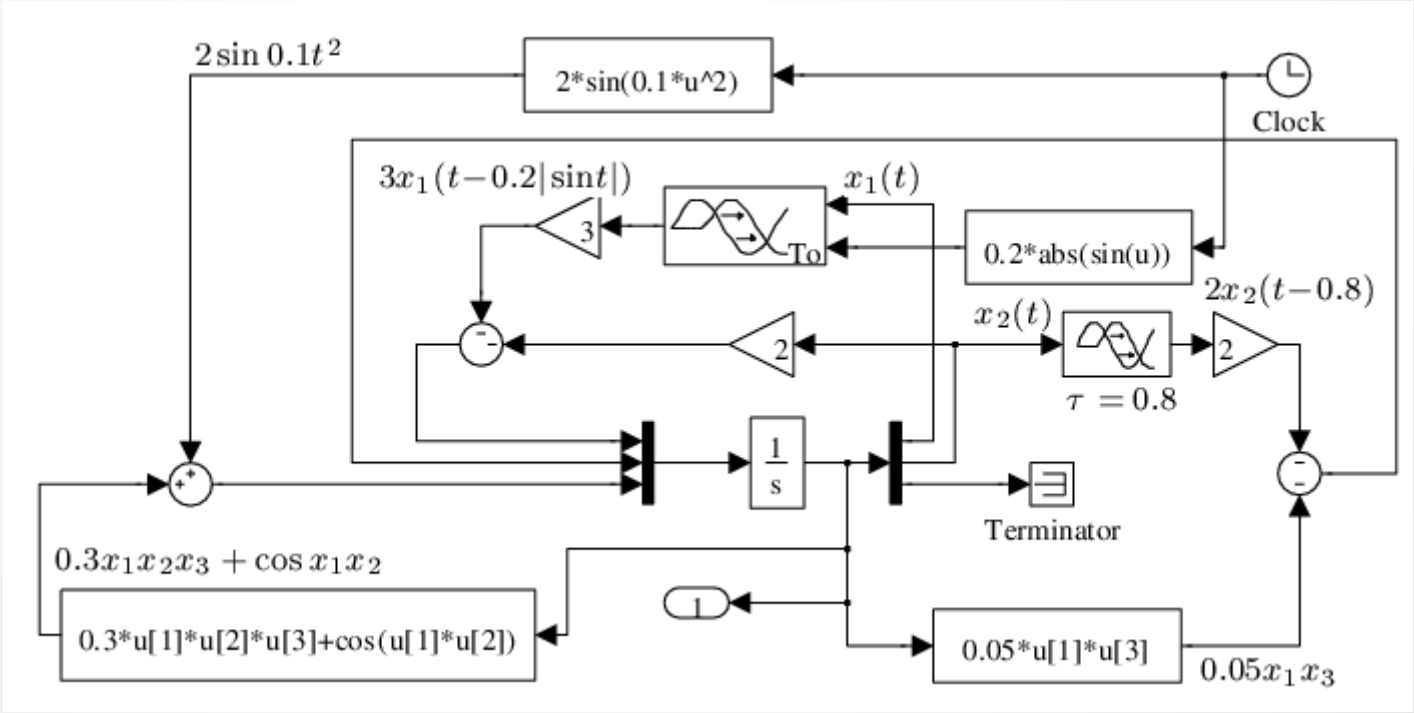
# 例6-8 变延迟系统仿真

- 变延迟

$$\begin{cases} \dot{x}_1(t) = -2x_2(t) - 3x_1(t - 0.2|\sin t|) \\ \dot{x}_2(t) = -0.05x_1(t)x_3(t) - 2x_2(t - 0.8) \\ \dot{x}_3(t) = 0.3x_1(t)x_2(t)x_3(t) + \cos(x_1(t)x_2(t)) + 2\sin 0.1t^2 \end{cases}$$



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