Ejemplo basado en una planta de primer orden más retraso

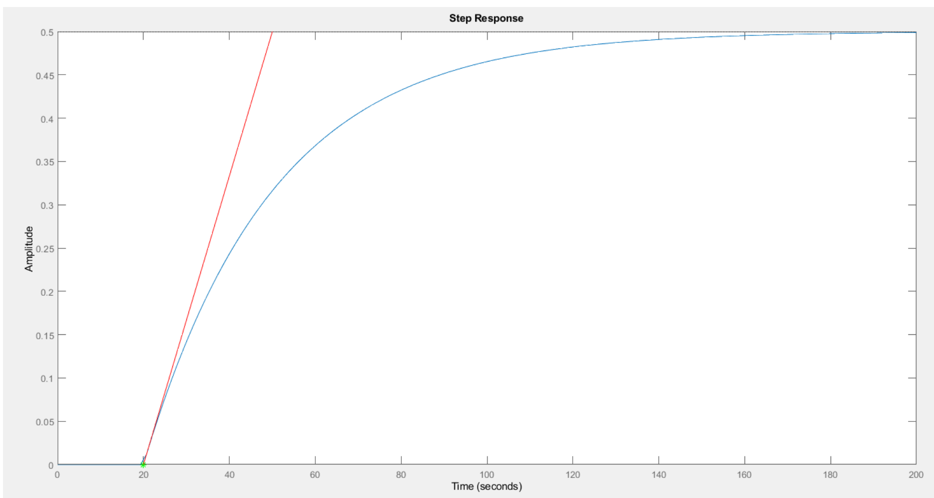
La respuesta escalón unitario de un modelo de función de transferencia de tiempo continuo

$$G(s) = \frac{0.5e^{-20s}}{30s + 1}$$

se muestra en una figura. En lugar de utilizar directamente el modelo de primer orden más retardo, encontraremos los parámetros del controlador PI utilizando los valores de τ_M, K_{ss} y retardo d.

Las coordenadas encontradas son $t_1 = 20, Y_0 = 0 \; y \;\; t_2 = 50.0250, Y_s = 0.5$.

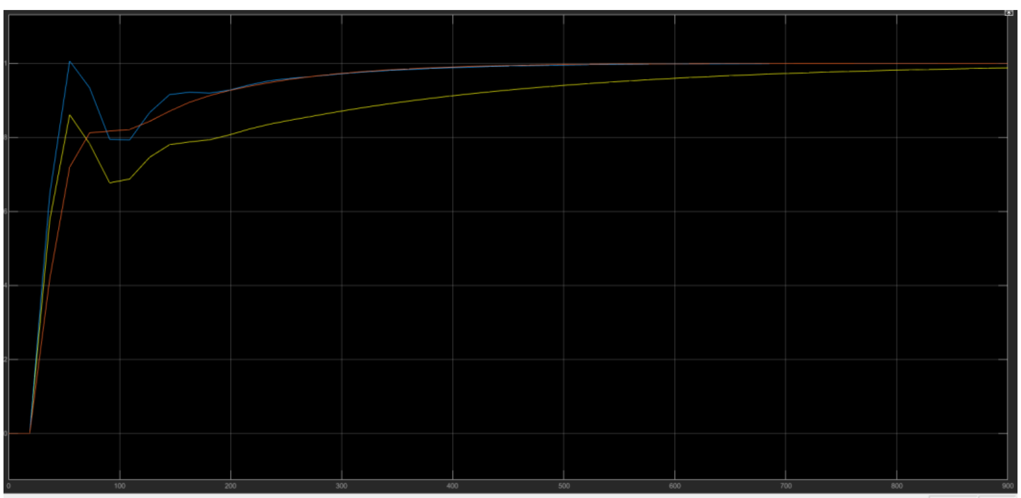
$$K_{ss}\frac{Y_s - Y_0}{U_s - U_0} = 0.5$$



d = $t_1 = 20$

$\tau_M = t_2 - t_1 = 50.0250 - 20 = 30.0250$

<table>
<tr><th>Controlador PI</th><th>K_c</th><th>τ_M</th><th>$K_{ss} = 0.5$</th><th>d=20</th><th>$\tau_M = 30.0250$</th></tr>
<tr><td>Ziegler–Nichols</td><td>2.70225</td><td>60</td><td colspan="3">Ziegler-Nichols tuning rules with a reaction curve.
<table>
<tr><th></th><th>K_c</th><th>τ_I</th><th>τ_D</th></tr>
<tr><td>P</td><td>$\frac{\tau_M}{K_{ss}d}$</td><td></td><td></td></tr>
<tr><td>PI</td><td>$0.9\frac{\tau_M}{K_{ss}d}$</td><td>$3d$</td><td></td></tr>
<tr><td>PID</td><td>$1.2\frac{\tau_M}{K_{ss}d}$</td><td>$2d$</td><td>$0.5d$</td></tr>
</table></td></tr>
<tr><td>Cohen–Coon</td><td>2.8689</td><td>28.6694</td><td colspan="3">Cohen–Coon tuning rules with a reaction curve.
<table>
<tr><th></th><th>K_c</th><th>τ_I</th><th>τ_D</th></tr>
<tr><td>P</td><td>$\frac{\tau_M}{K_{ss}d}\left(1+\frac{d}{3\tau_M}\right)$</td><td></td><td></td></tr>
<tr><td>PI</td><td>$\frac{\tau_M}{K_{ss}d}\left(0.9+\frac{d}{12\tau_M}\right)$</td><td>$\frac{d(30\tau_M+3d)}{9\tau_M+20d}$</td><td></td></tr>
<tr><td>PID</td><td>$\frac{\tau_M}{K_{ss}d}\left(\frac{4}{3}+\frac{d}{4\tau_M}\right)$</td><td>$\frac{d(32\tau_M+6d)}{13\tau_M+8d}$</td><td>$\frac{4d\tau_M}{11\tau_M+2d}$</td></tr>
</table></td></tr>
<tr><td>Wang–Cluett</td><td>1.7912</td><td>34.6899</td><td colspan="3">Wang–Cluett tuning rules with reaction curve ($L = \tau_M/d$).
<table>
<tr><th></th><th>K_c</th><th>τ_I</th><th>τ_D</th></tr>
<tr><td>P</td><td>$\frac{0.13+0.51L}{K_{ss}}$</td><td></td><td></td></tr>
<tr><td>PI</td><td>$\frac{0.13+0.51L}{K_{ss}}$</td><td>$\frac{d(0.25+0.96L)}{0.93+0.03L}$</td><td></td></tr>
<tr><td>PID</td><td>$\frac{0.13+0.51L}{K_{ss}}$</td><td>$\frac{d(0.25+0.96L)}{0.93+0.03L}$</td><td>$\frac{d(-0.03+0.28L)}{0.25+L}$</td></tr>
</table></td></tr>
</table>



```
s = tf('s');
G= (0.5*exp(-20*s))/(30*s+1)

step(G);
hold on
dt=.05;
t=0:dt:400;
y=step(G,t);
dy=diff(y)/dt;

[m,p]= max(dy)

y1= y(p)
t1=t(p)

plot(t1,y1,'*g')
hold on
t2= 0:1:500;
y2=m*(t2-t1) + y1;
x2=0.5/m +20%se modifica en funcion al tiempo de asentamiento
hold on
plot(t2,y2,'r')
plot(y2,t1,'or')
```