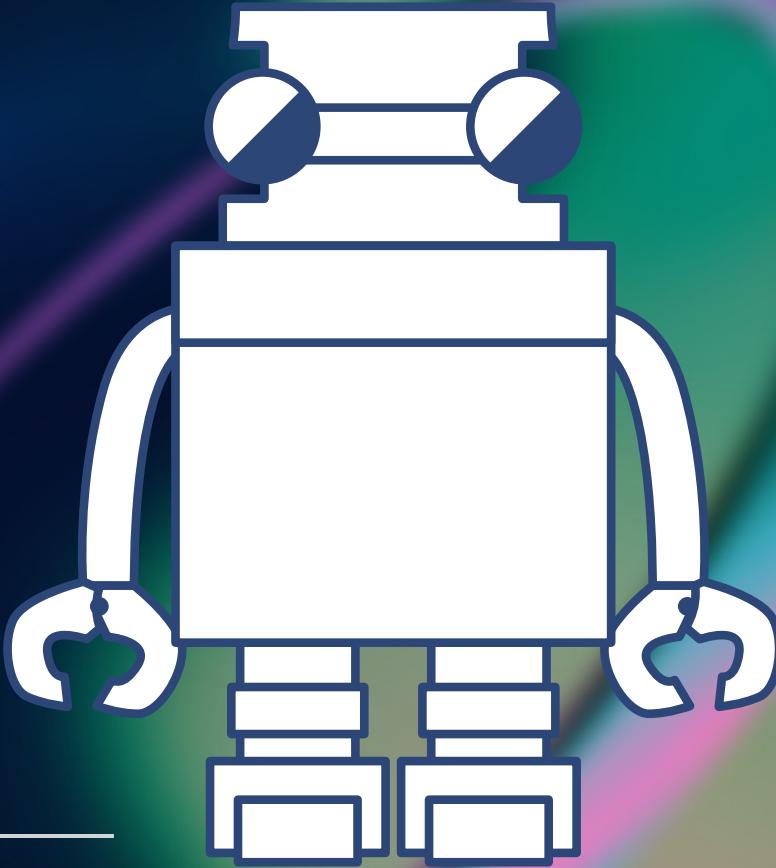


# CONTROL LQG

Add a short description



# CONTENIDO



**DISEÑO**



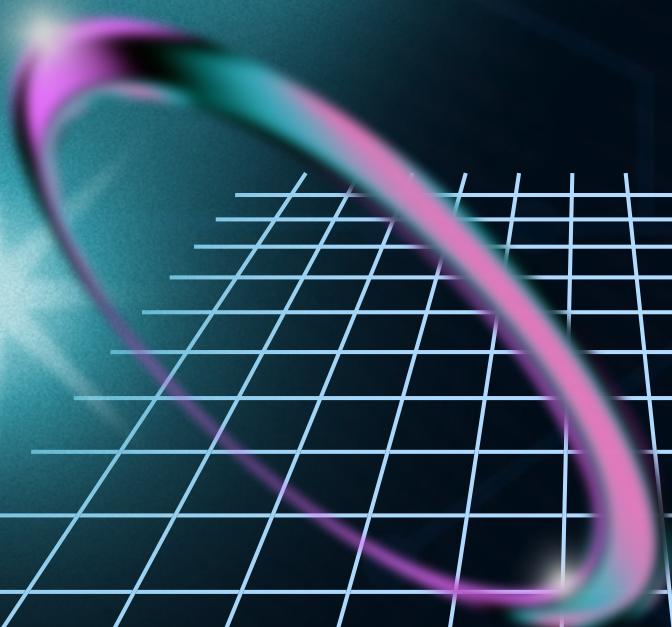
**SIMULACIÓN**



**GRÁFICAS**

# DISEÑO DEL CONTROLADOR LOG

CONTROL I



# RESULTADO

## GANANCIAS DE KALMAN

L =

**14.9213**

**112.5300**

**79.9342**

**845.3911**

## GANANCIAS DEL LQR

K=

**1.0000**

**0.1543**

**-0.0194**

**-0.0047**

```
%SISTEMA
A=[0,1,0,0;0,0,-9.41492892836899,0;0,0,0,1;0,0,-192.249289283690,0];
B=[0;141.136429339344;0;1411.36429339344];
C=[1,0,0,0];
D=0;
sys=ss(A,[B B],C,0);
%RUIDO
w=0.01*randn(1,1000);
v=0.01*randn(1,1000);
%DATOS DEL RUIDO
Mean_w=mean(w);
Var_w=(std(w))^2;
Mean_v=mean(v);
Var_v=(std(v))^2;
%matriz de covarianzas
Q = (w*w');
R = (v*v');
N=w*v';
%KALMAN
[kalmf,L,P] = kalman(sys,Q,R,N);
%LQG
Q2=C'*C;
R2=1;
[K,S,e]=lqr(A,B,Q2,R2);
Nbar=-inv(C*inv(A-B*K)*B);
```

# PROGRAMA EN C++

LQGV2FINAL

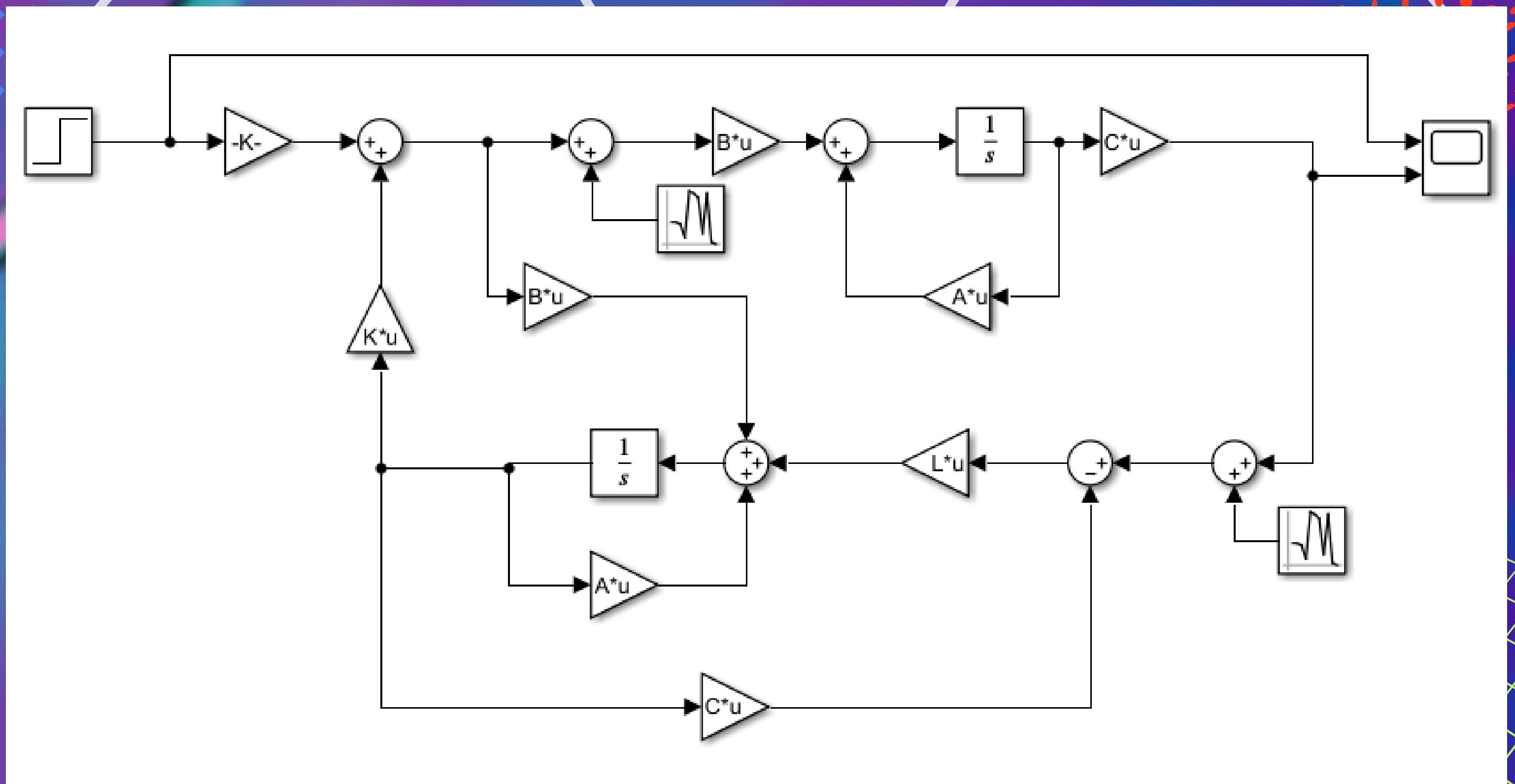
```
1 const float Q_distance=2.7;//1 2.7
2 const float R_measure=3.3;//1 2.7
3 float distance=0;
4 float P=0;
5 float K=0;
6 float y=0;
7 float S=0;
8 /////////////
9 /////////////
```

```
263
264 float KalmanFilter(float newDistance, float dt){
265     //distance=distance; //priori distance
266     P+=Q_distance*dt; //estimation error covariance
267     //Kalman gain
268     S=P+R_measure;
269     K=P/S;
270     //Update whith measurement
271     y=newDistance-distance;
272     //Calculate distance
273     distance+=K*y;
274     //Update the error covariance
275     P*=(1-K);
276 }
277 }
```

```
68 //lqr///
69 float x1,x2,x3,x4;
70 float x1_ant=0;
71 float x3_ant=0;
72 float k[4]={-1.122,-1.68,52.76,719};//-1.22,0.5,30.755,150// -1.22,-0.13,33,100// -1.22,-0.13,37.799,950
73 int SetPoint=0;
74 float input;
75 //double dt=0,dt2=0.0001;
76 volatile double U;
77 /////////////
```

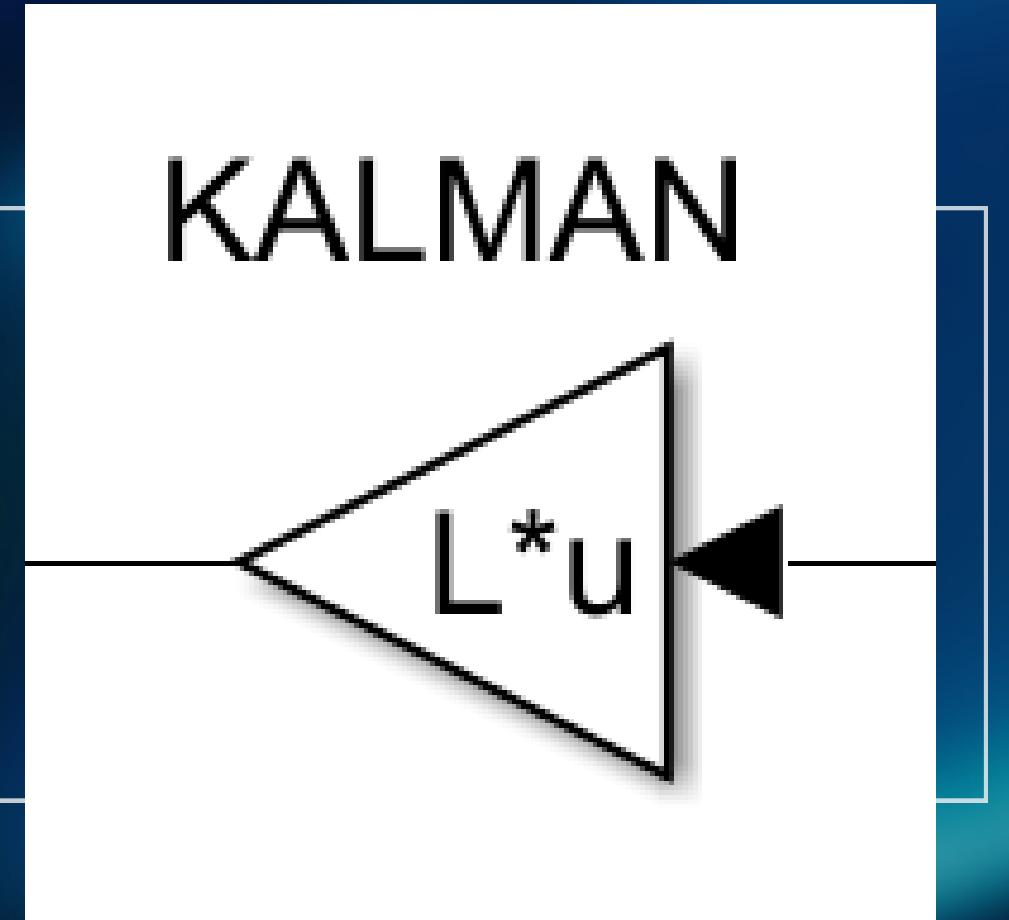
# **SIMULACIÓN DEL CONTROLADOR LQG**

[Back to Agenda Page](#)

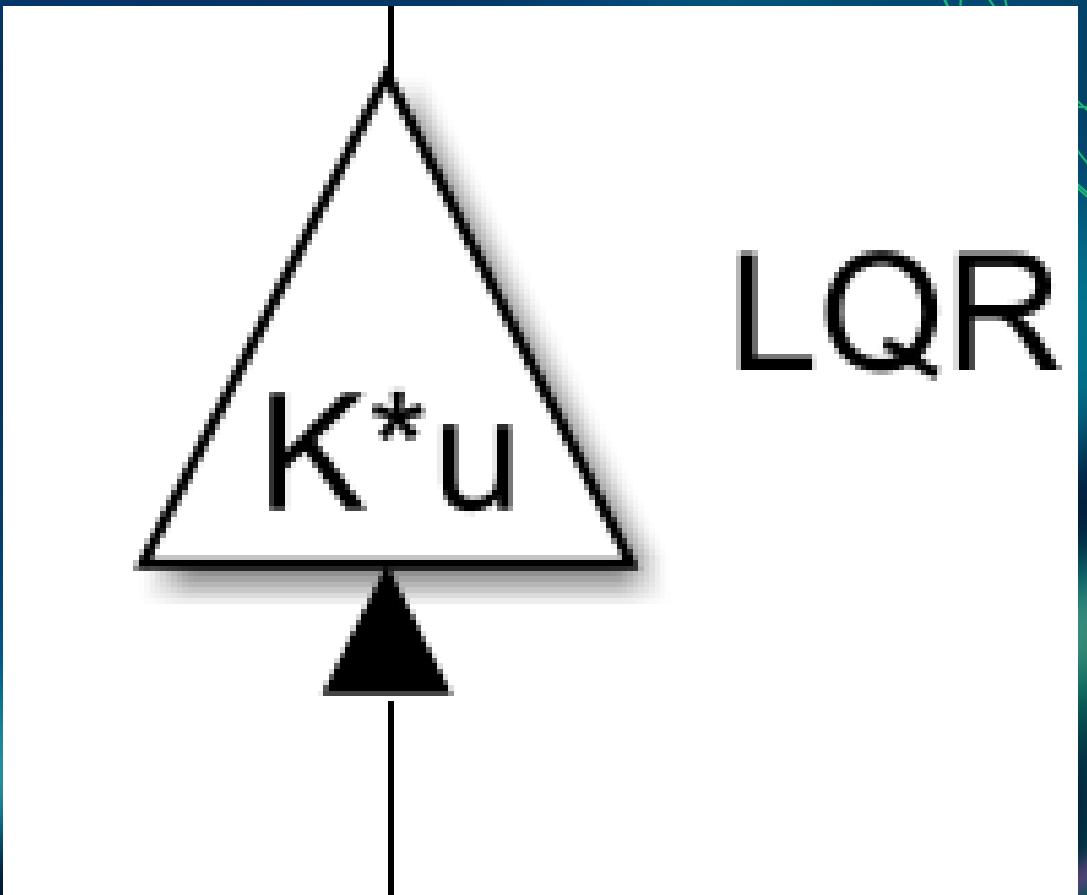




**Bloque se encarga de colocar ruido al sistema-**



**Bloque que tiene las ganancias de Kalman que se hallaron de manera teórica**



**Bloque que tiene las ganancias para la parte del LQR del sistema**

# RESULTADO



# PROGRAMA

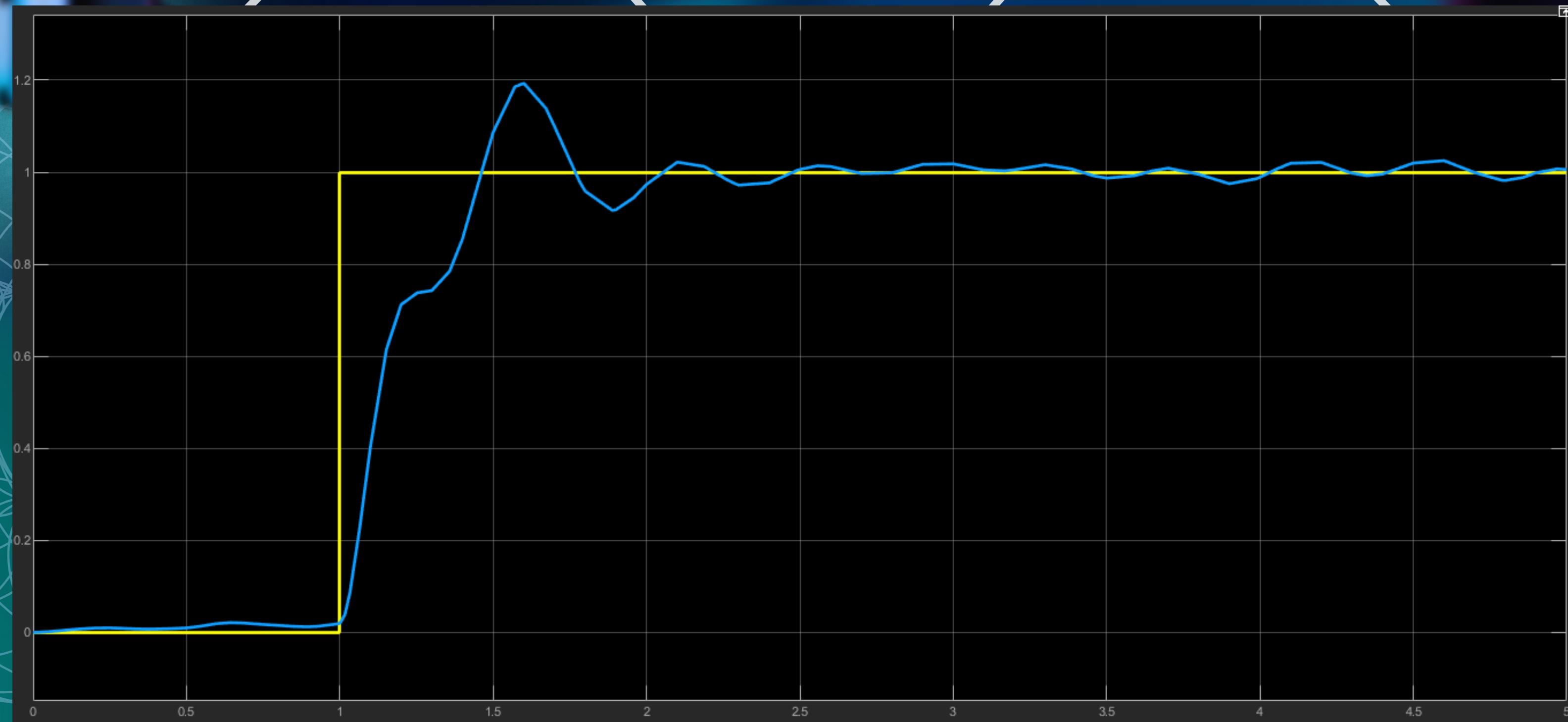
```
281 void loop() {///
282   now=millis();
283   chtime=now-pasTime;
284   sampleEncoders();
285   xl=motorAngularPosition;
286   x3=Angle()-182.7;///sensor izq 182.7
287   if(chtime>=Ts){
288     //Serial.print(int(KalmanFilter(x3,chtme*10000)));
289     //Serial.print(' ');
290     //Serial.println(KalmanFilter(x3,chtme*1000000000));
291     Serial.print("Desplazamiento: ");
292     Serial.print(xl);/*abs(cos(x3)));
293     x2=((xl - xl_ant)/ chtime);//(xl-xl_ant)/dt2;
294     Serial.print(",  Vel-Desp: ");
295     Serial.print(x2);
296     Serial.print(",  Angle: ");
297     Serial.print(int(KalmanFilter(x3,chtme*1000000000)));
298     x4=(KalmanFilter(x3,chtme*100000000)-x3_ant)/chtme;
299     Serial.print(",  Vel-Angle: ");
300     Serial.print(x4);
301     Serial.print(",    dt: ");
302     Serial.print(chtime);
303     /////////////////////////////////
304     U=-((k[0]*(SetPoint-xl))+(k[1]*x2)+(k[2]*KalmanFilter(x3,chtme*1000000))+ (k[3]*x4));
305     /////////////////////////////////
306     U=constrain(U,-350,350);
307     Serial.print(" ,  U: ");
308     Serial.print(U);
309     U=map(U,-350,350,-120,120); //90vel
310     Serial.print(" ,  MOTORES: ");
311     Serial.println(U);
312     motorController.move(U,MIN_ABS_SPEED);
313     pasTime=now;
314   }
315   xl_ant=xl;
316   x3_ant=KalmanFilter(x3,chtme*1000000000);
317 }
```

# LEY DE CONTROL

# GRÁFICAS DE ESTABILIZACIÓN DEL SISTEMA

CONTROL I

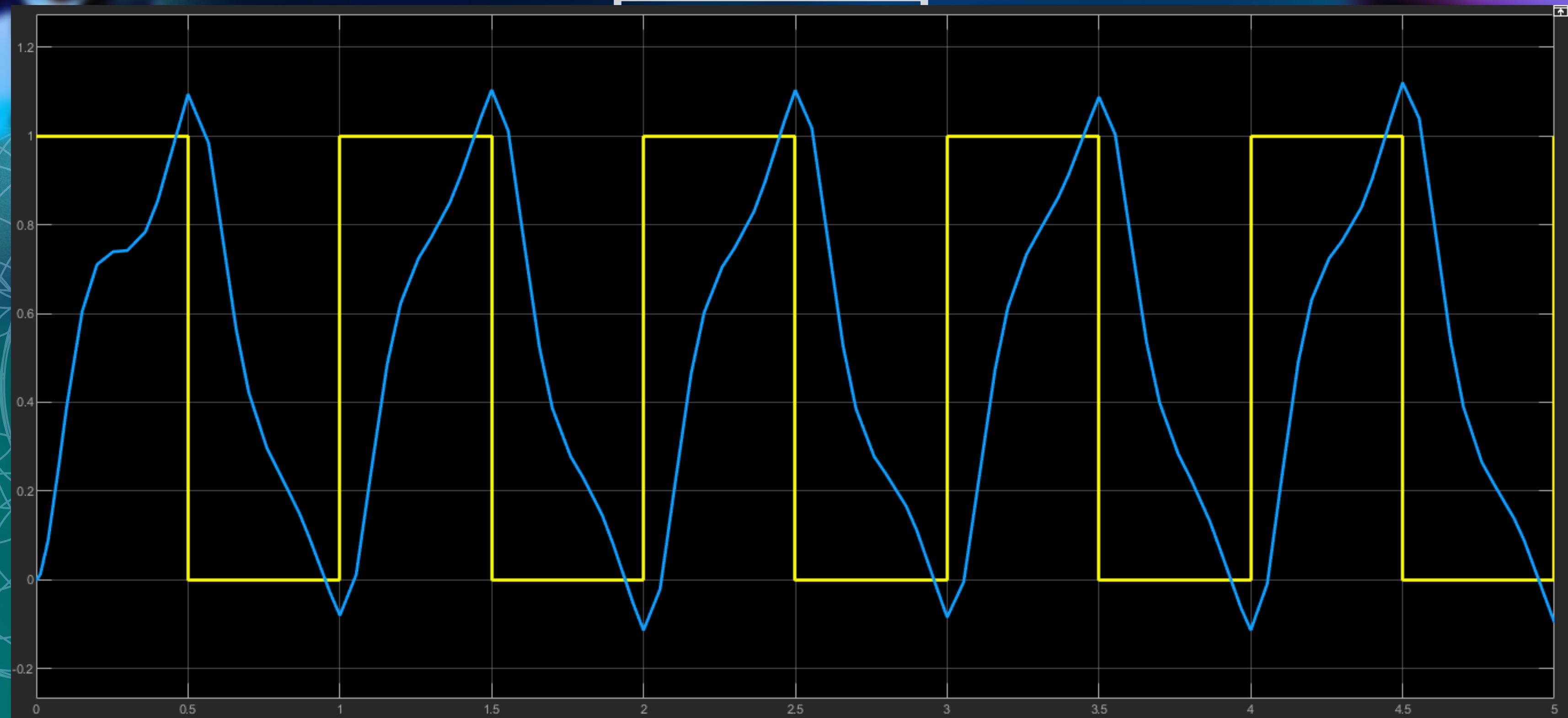
# GRÁFICAS (SISTEMA NORMAL)



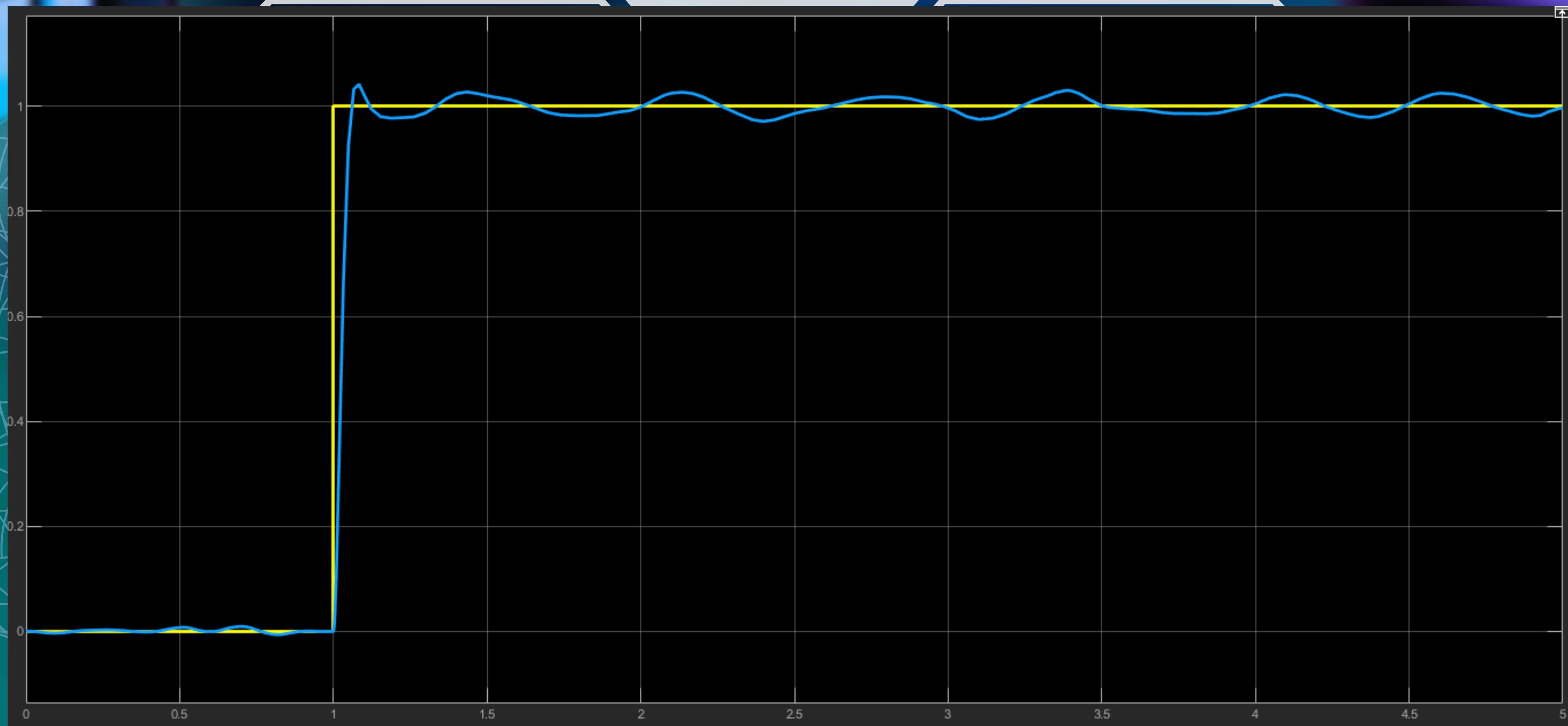
[Back to Agenda Page](#)



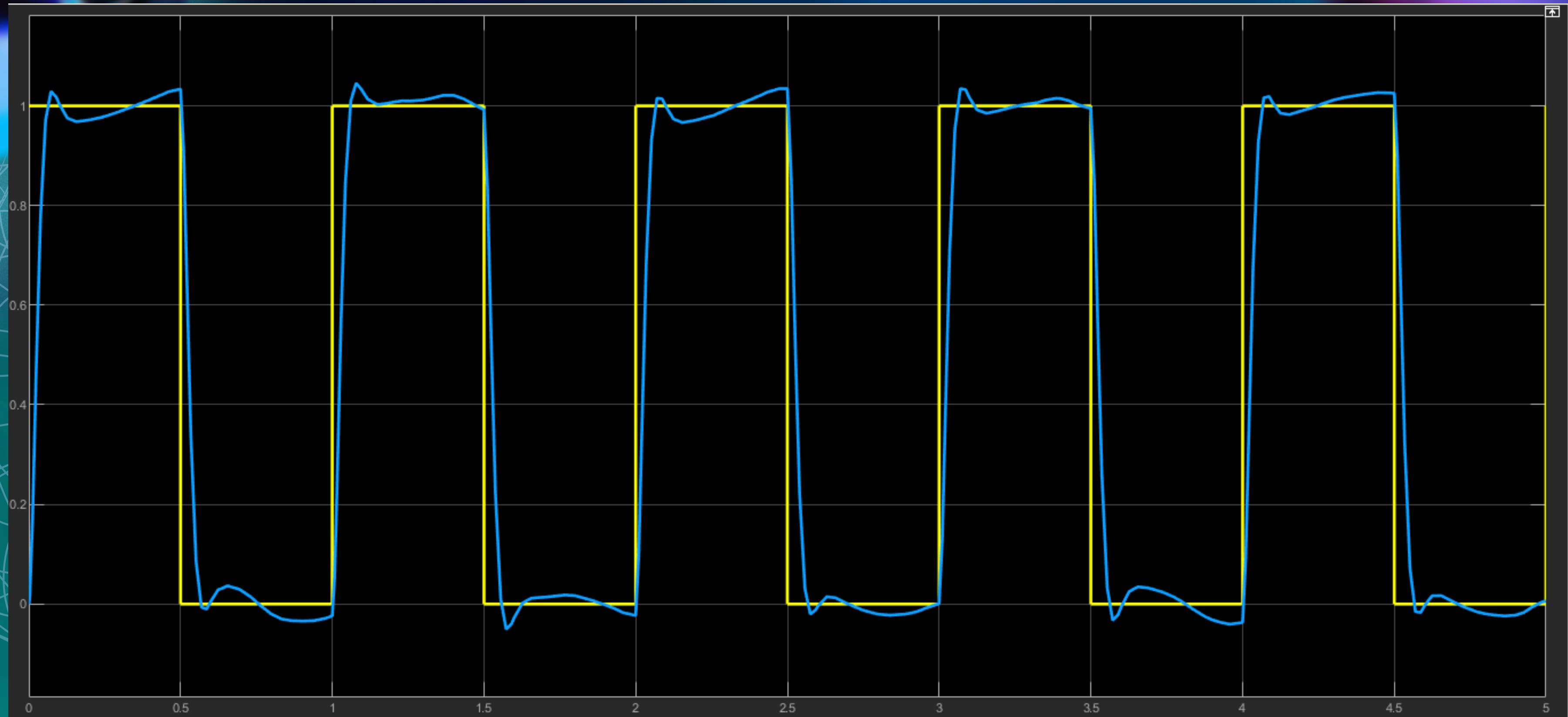
# DESEMPEÑO ANTE IMPULSOS



# GRÁFICAS (SISTEMA VELOZ)



# DESEMPEÑO ANTE IMPULSOS



## DESEMPEÑO DEL SISTEMA ORIGINAL (NBAR=1)

- **RiseTime: 0.3852 s**
- **SettlingTime: 4.8333 s**
- **Overshoot: 18.6730 %**
- **SSE= 2.4% aprox.**

### Ganancias LQR

1.0000
0.1543
-0.0194
-0.0047

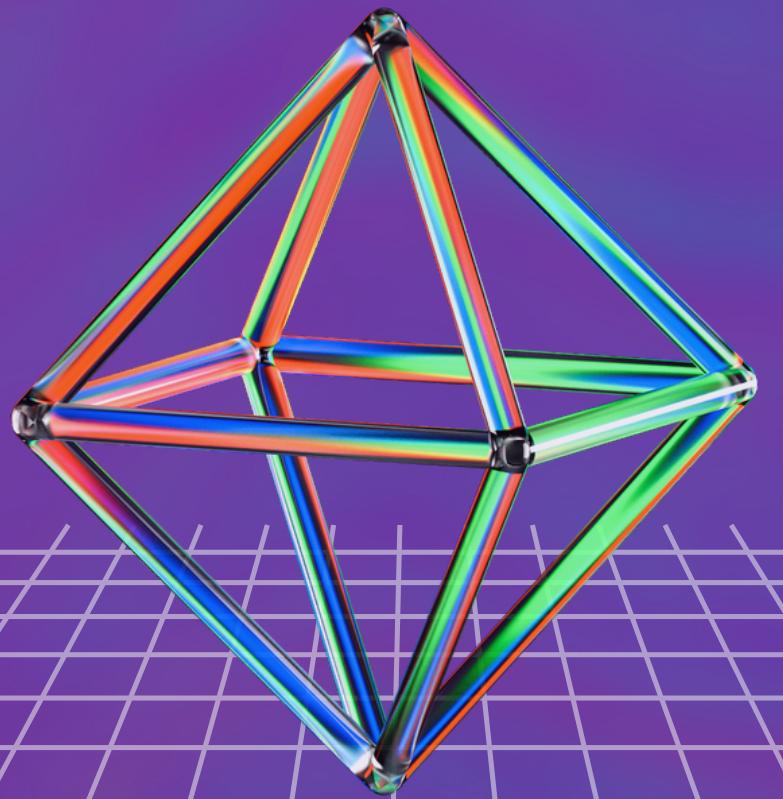
## DESEMPEÑO DEL SISTEMA VELOZ (NBAR=22.3607)

- **RiseTime: 0.0382 s**
- **SettlingTime: 4.6940 s**
- **Overshoot: 4.5676 %**
- **SSE= 2.2% aprox.**

### Ganancias LQR

22.3607
0.6220
-0.0514
-0.0066

THANK YOU!



¡Escanéame!