Suspensie Activă

Sisteme Robuste

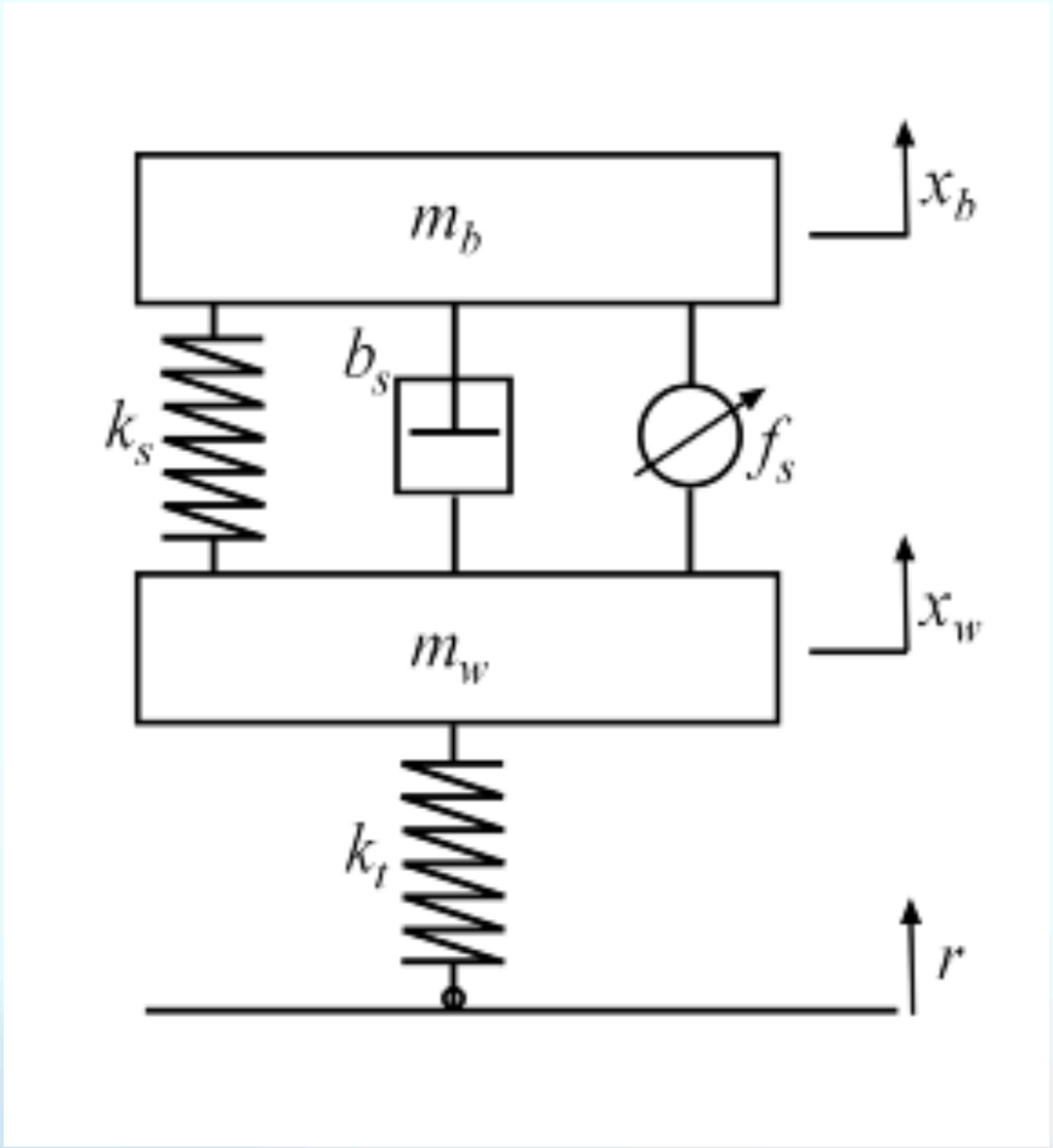
Ceoca Ovidiu, 26 iunie 2024

Structura prezentării

- Modelul fizic al unei suspensii active
- Definirea sistemului
- Definirea problemei
- Extinderea modelului
- Calculul regulatorului folosind H_∞
- Introducere incertitudini in sistem
- Calculul regulatorului folosind μ-Synthesis
- Concluzii

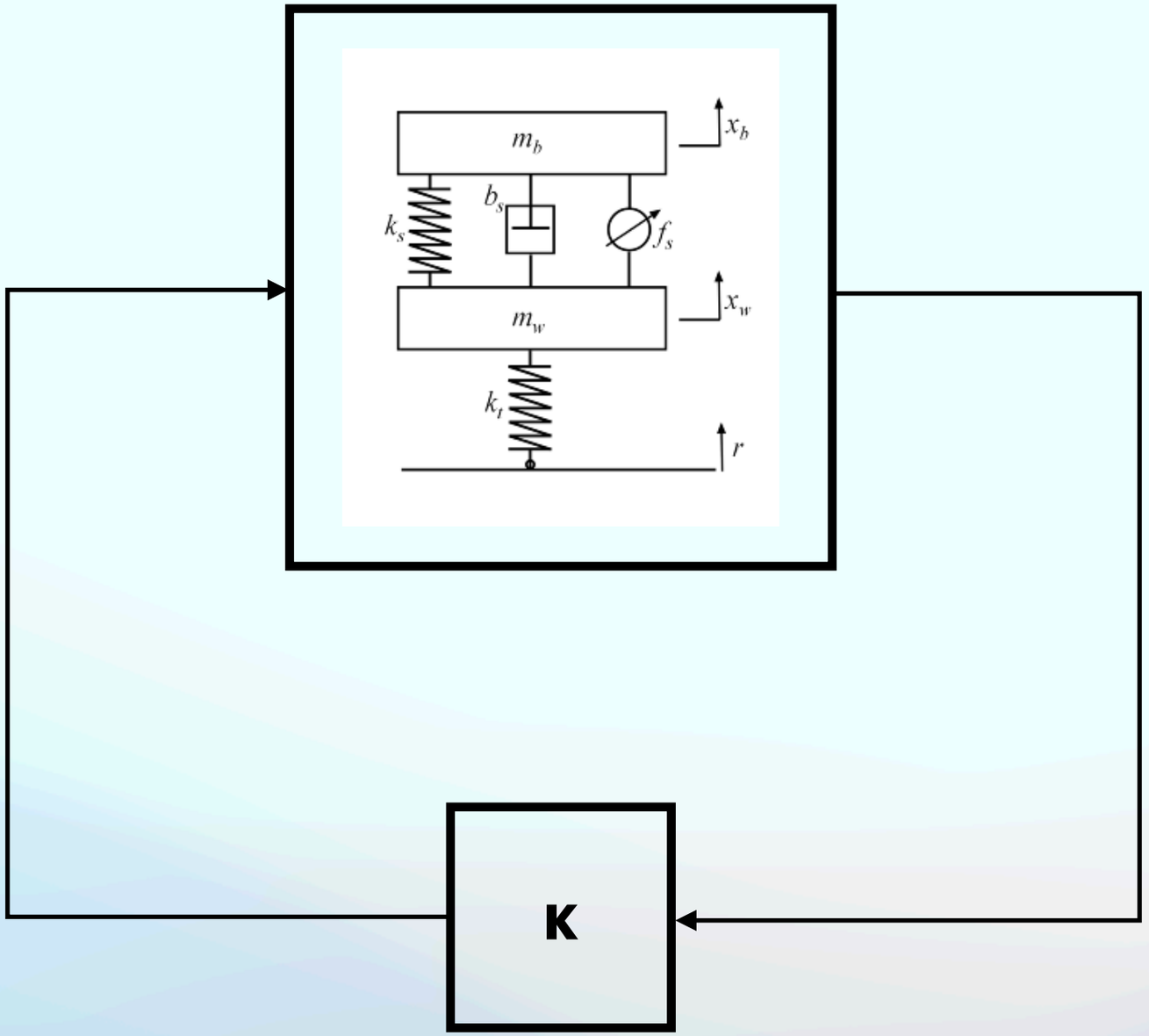
Modelul fizic

Modelul fizic

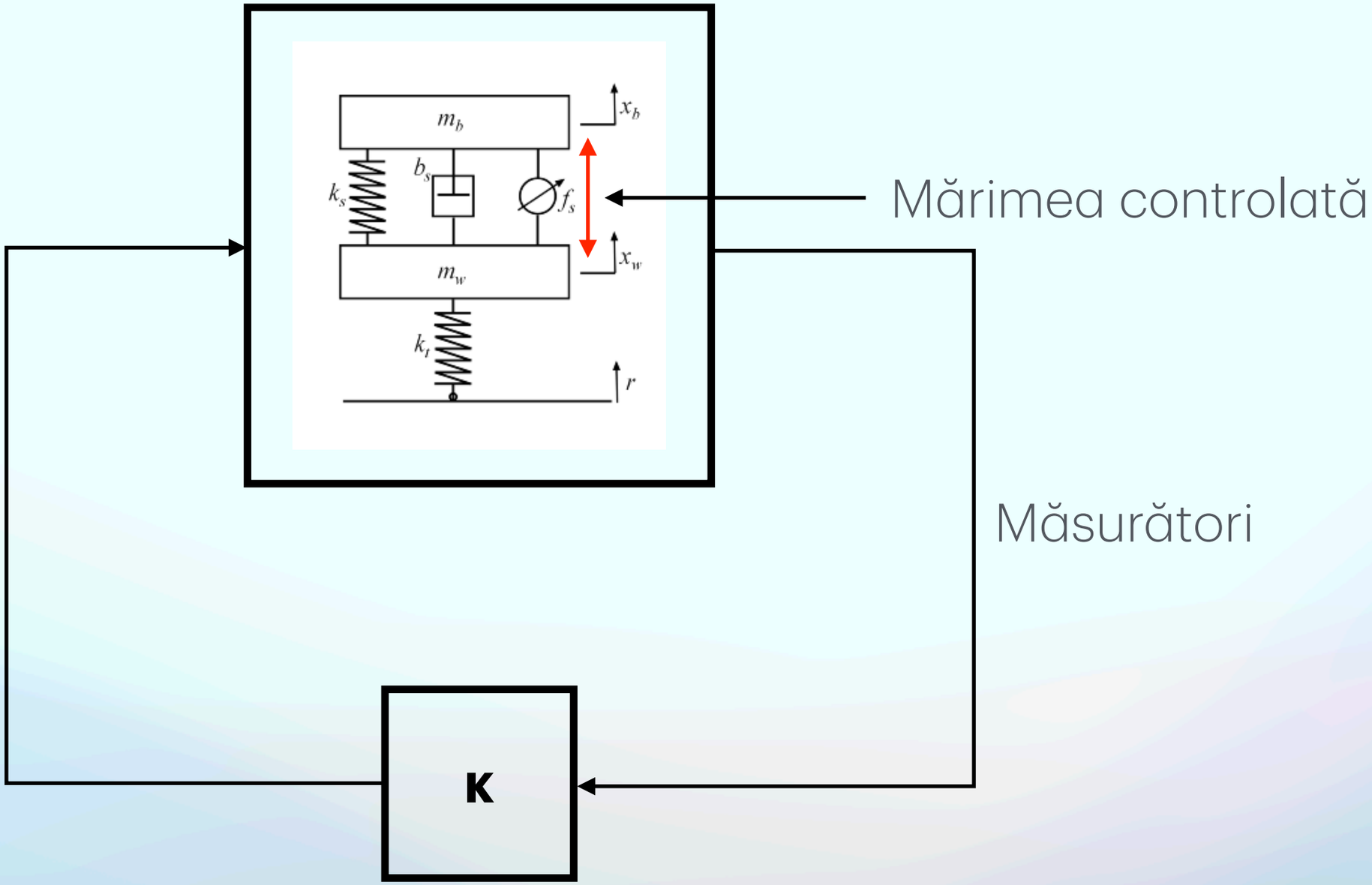


Definirea sistemului

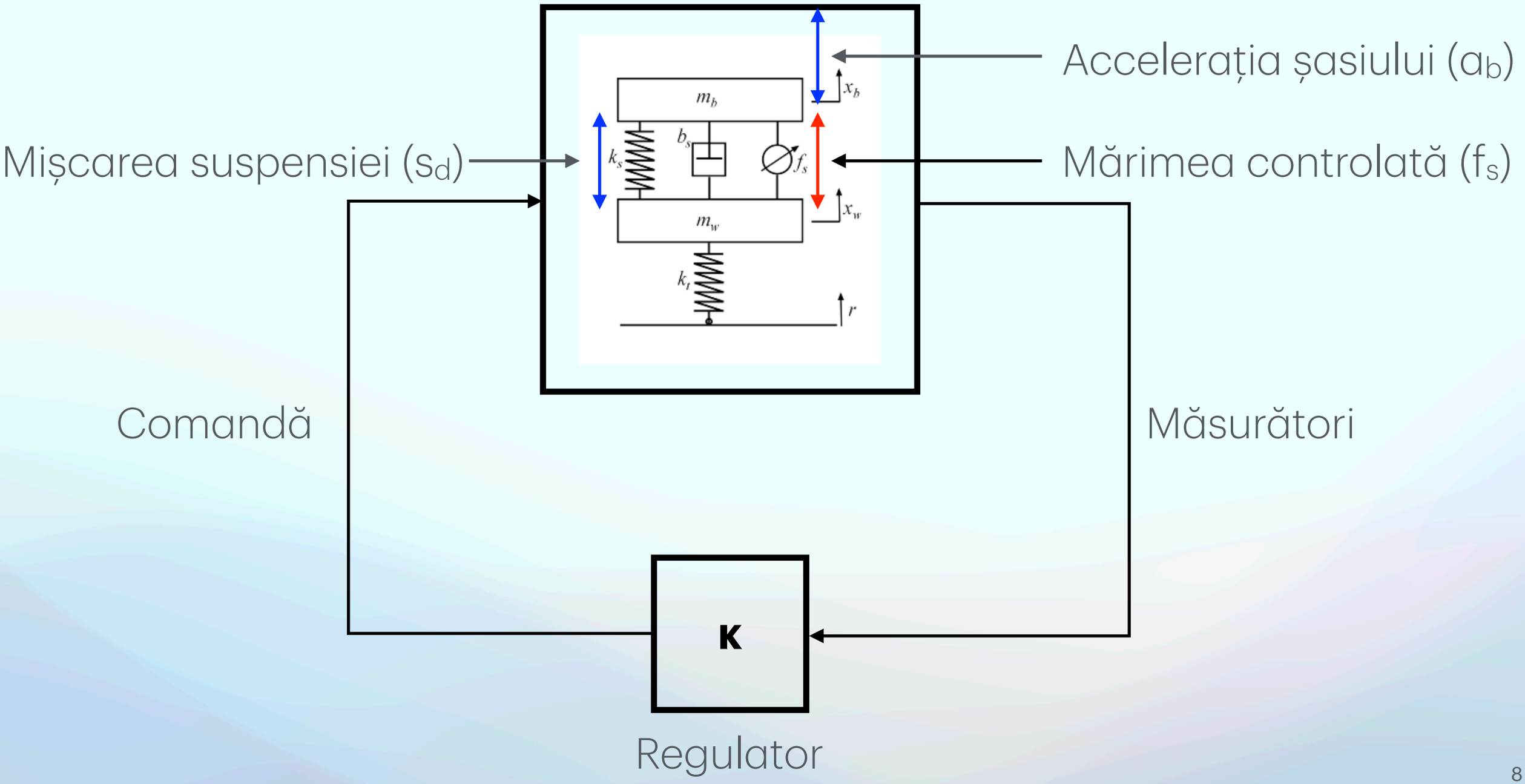
Definirea sistemului



Definirea sistemului

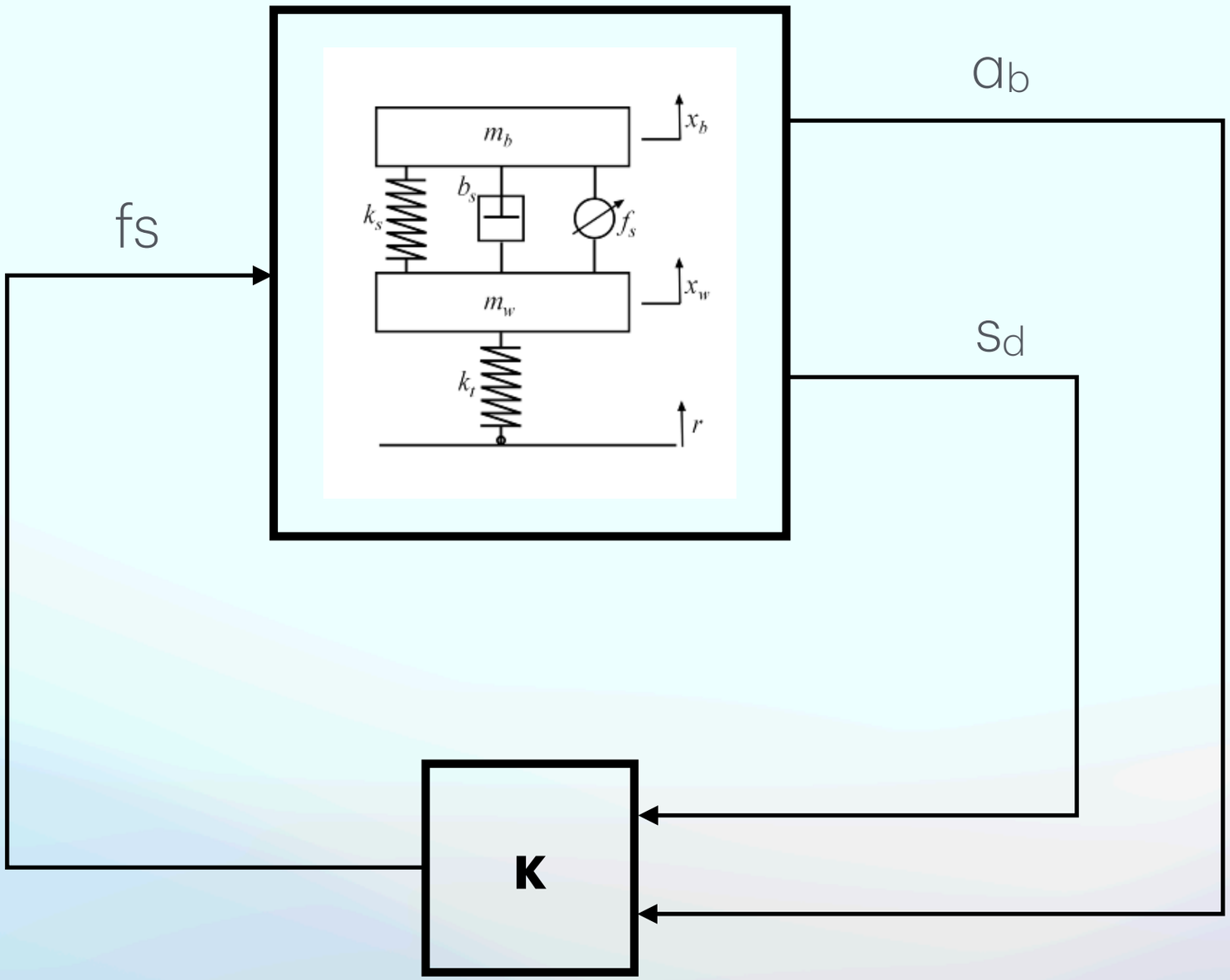


Definirea sistemului



Definirea problemei

Definirea problemei



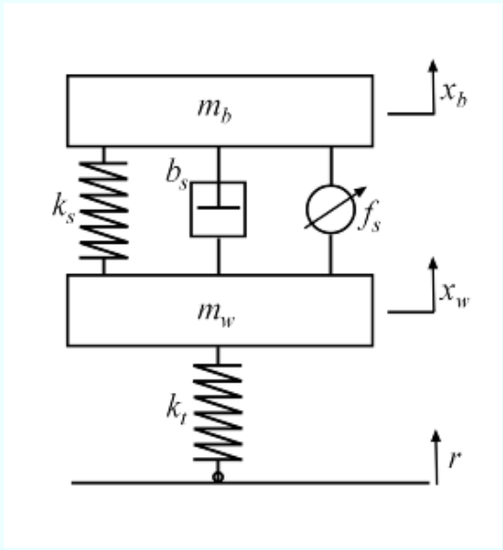
Regulator

Extinderea modelului

Extinderea modelului

Perturbații (W)

u



a_b

s_d

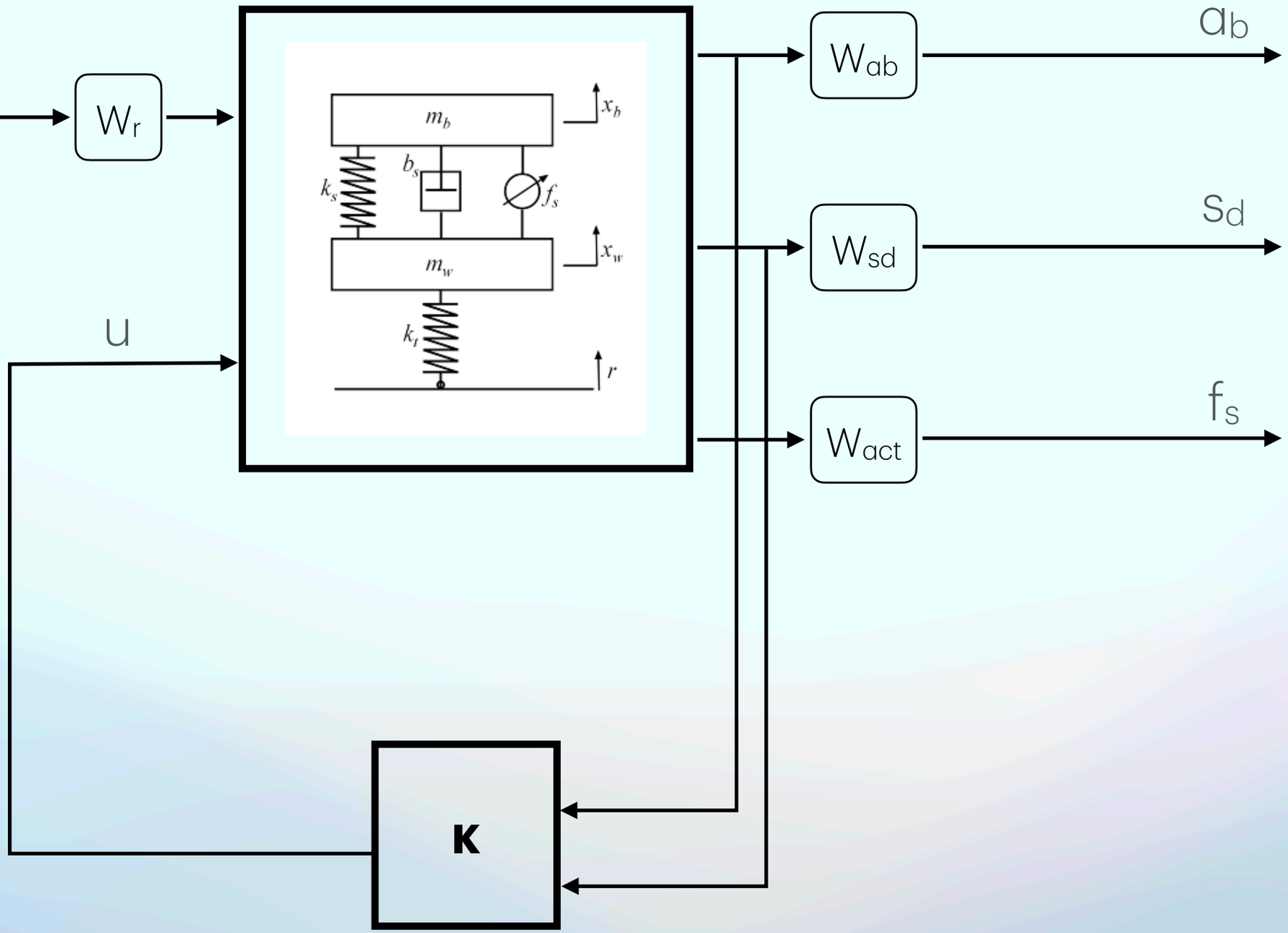
f_s

K

Regulator

Extinderea modelului

Perturbații (W)



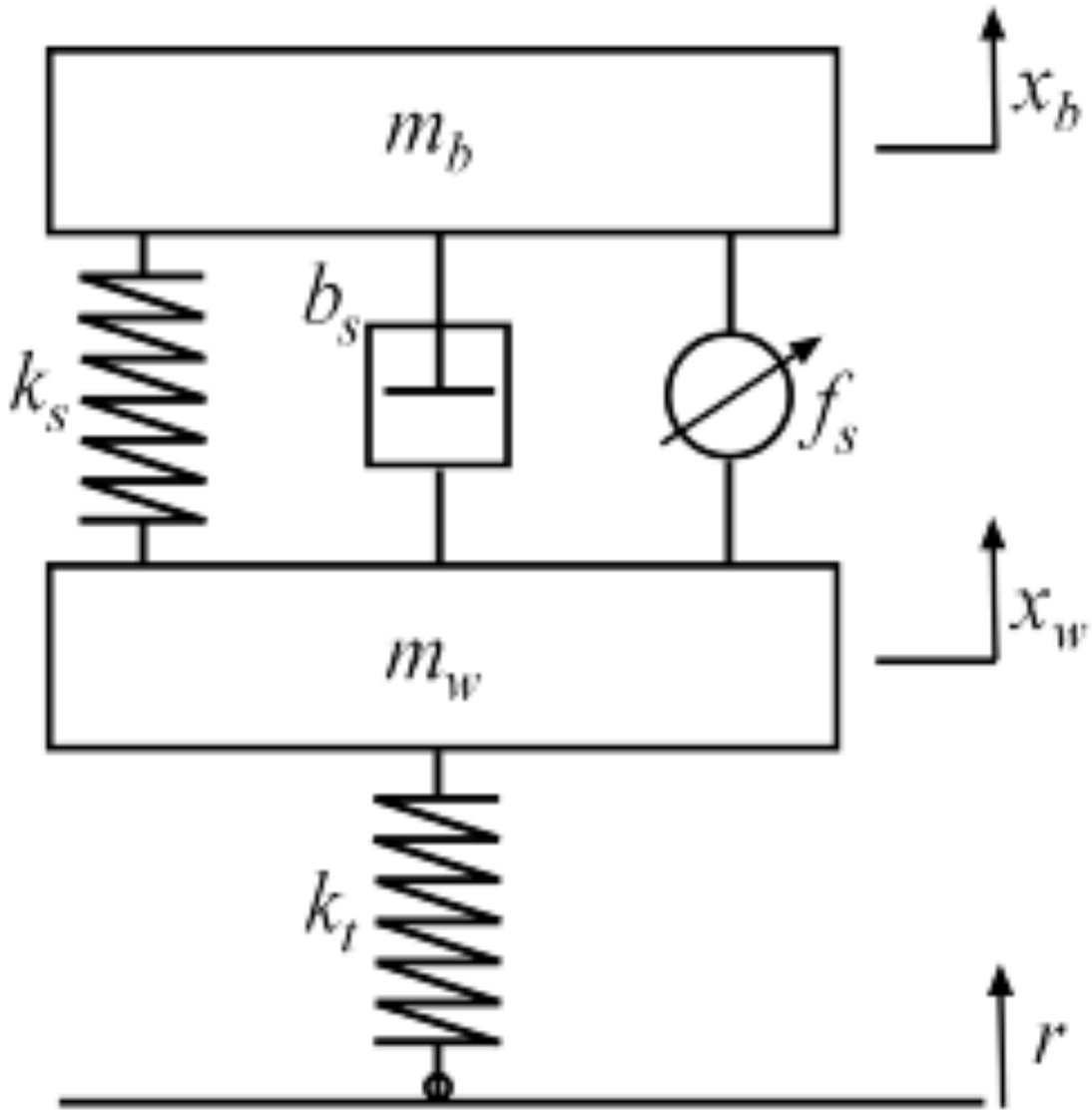
Regulator

Calculul regulatorului folosind H∞

Calcul regulator

Date model

- m_b = 300 Kg
- m_w = 60 Kg
- b_s = 1000 N/(m*s)
- k_s = 16000 N/m
- k_t = 190000 N/m



Calcul regulator

Model matematic

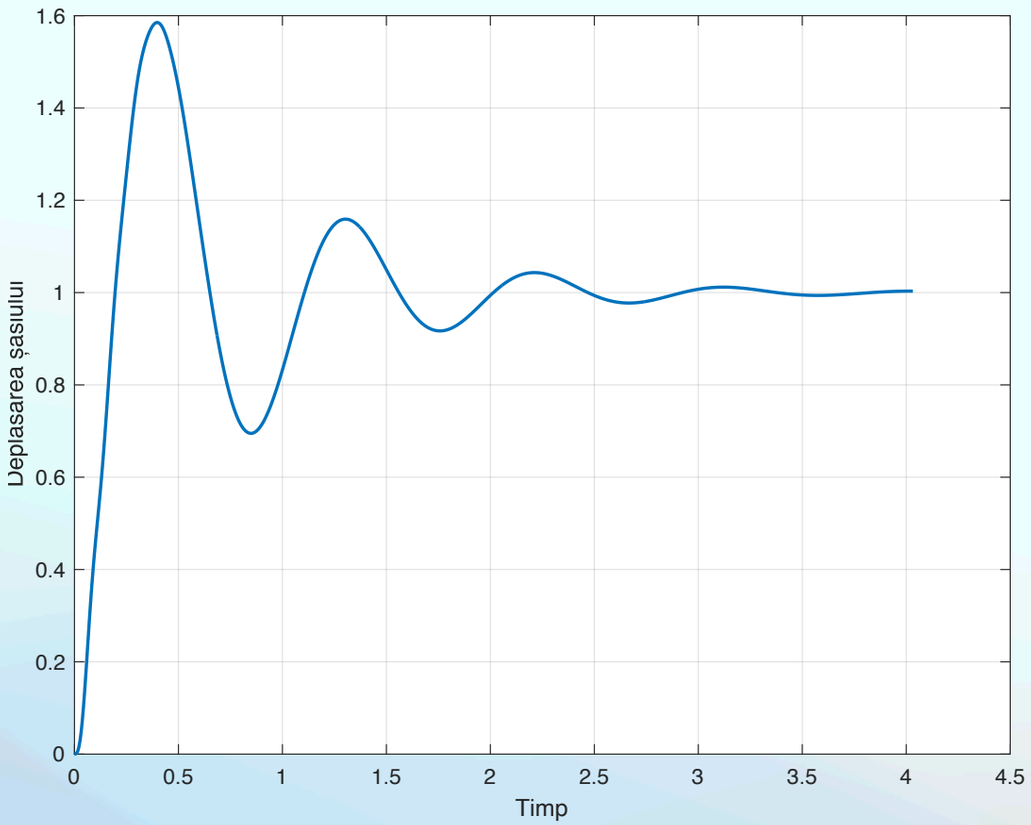
$$A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ \frac{-k_s}{m_b} & \frac{-b_s}{m_b} & \frac{k_s}{m_b} & \frac{b_s}{m_b} \\ 0 & 0 & 0 & 1 \\ \frac{k_s}{m_w} & \frac{b_s}{m_w} & \frac{-k_s - k_t}{m_w} & \frac{-b_s}{m_w} \end{bmatrix} \qquad B = \begin{bmatrix} 0 & 0 \\ 0 & \frac{1e3}{m_b} \\ 0 & 0 \\ \frac{k_t}{m_w} & \frac{-1e3}{m_w} \end{bmatrix}$$

$$C = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 0 & -1 & 0 \\ \frac{-k_s}{m_b} & \frac{-b_s}{m_b} & \frac{k_s}{m_b} & \frac{b_s}{m_b} \end{bmatrix} \qquad D = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & \frac{1e3}{m_b} \end{bmatrix}$$

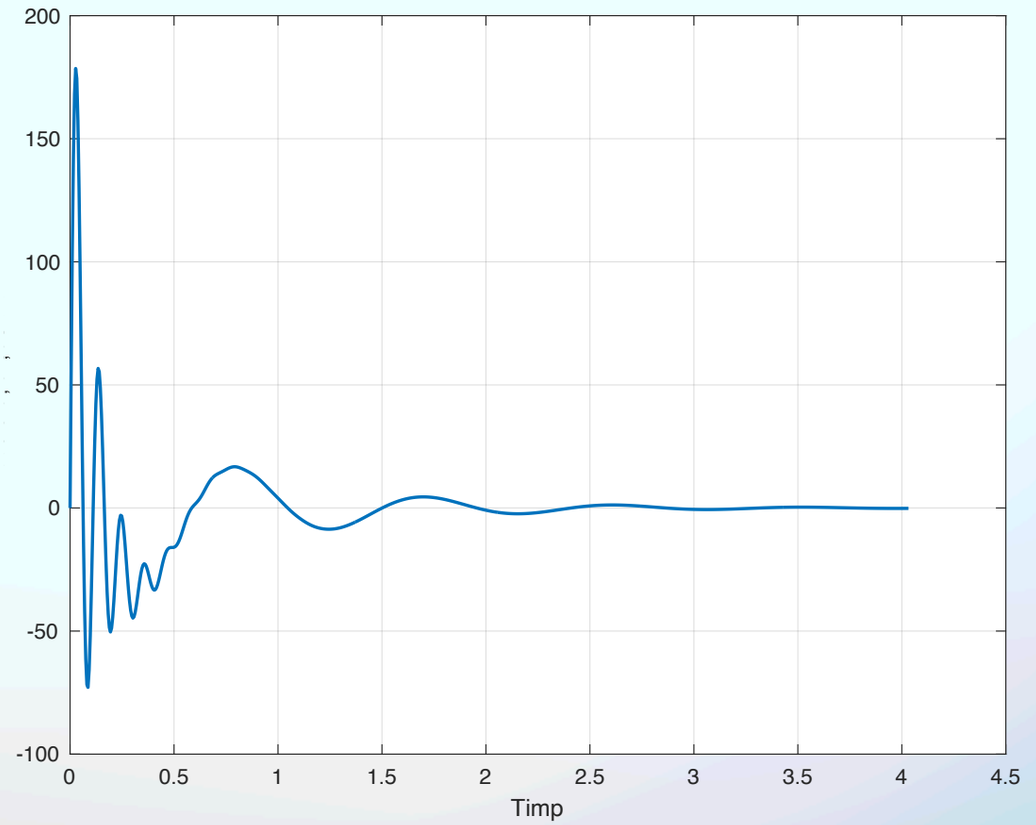
Calcul regulator

Simulare sistem fără regulator

Deplasarea șasiului



Accelerația șasiului



Calcul regulator

Model matematic actuator

$$H_{act} = \frac{1}{0.01667s + 1}$$

Calcul regulator

Moduri tratate

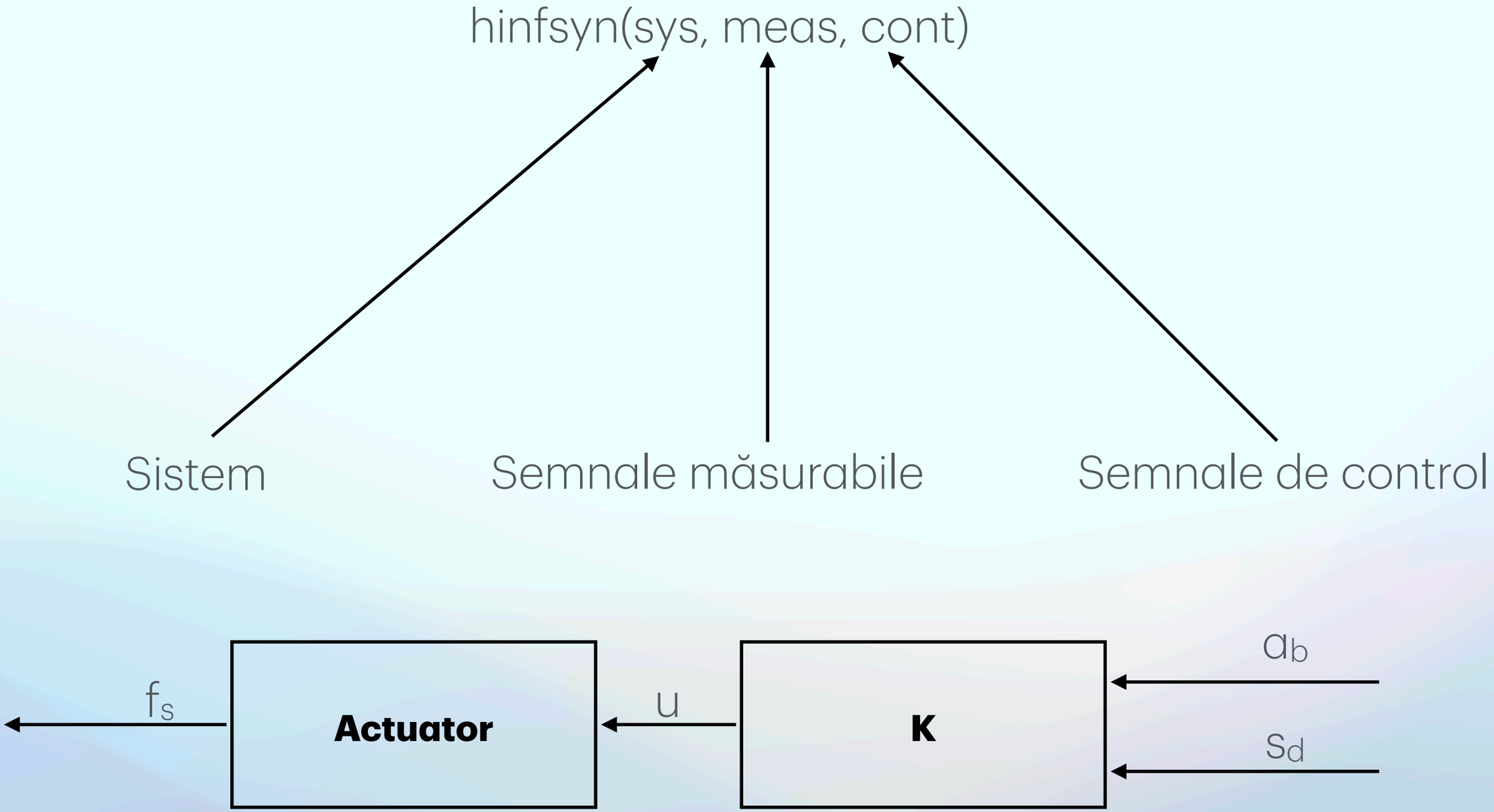
Comfort

Standard

Sport

Calcul regulator

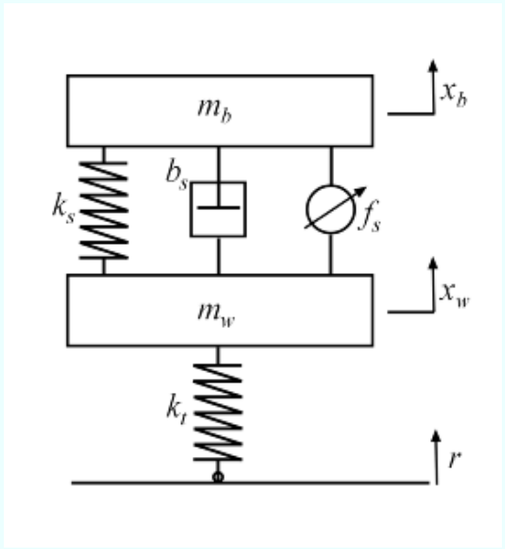
Regulator folosind H_∞



Calcul regulator

Bucla închisă

W_r



W_{ab}

a_b

W_{sd}

s_d

f_s

Actuator

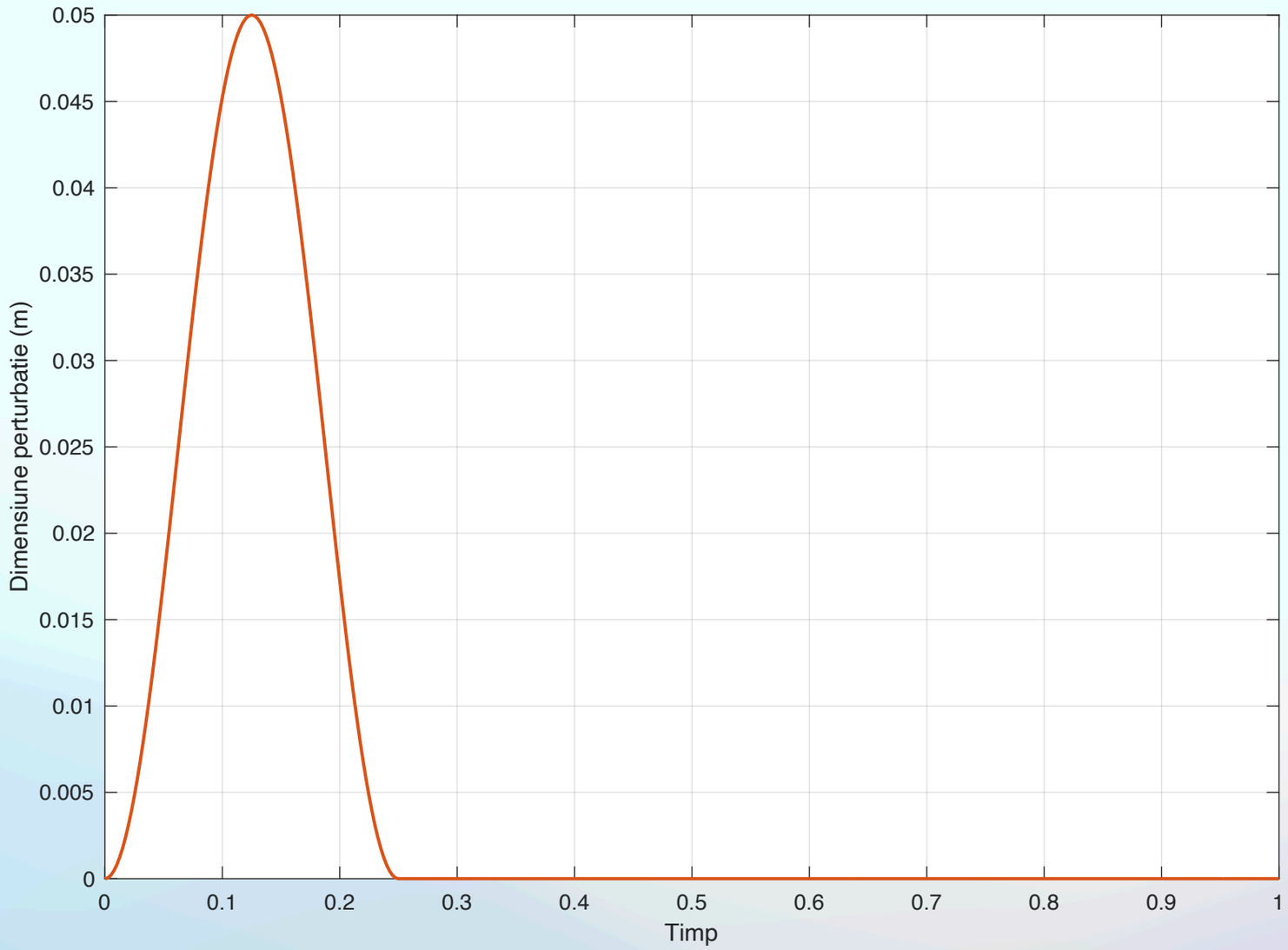
u

K

Regulator H_∞

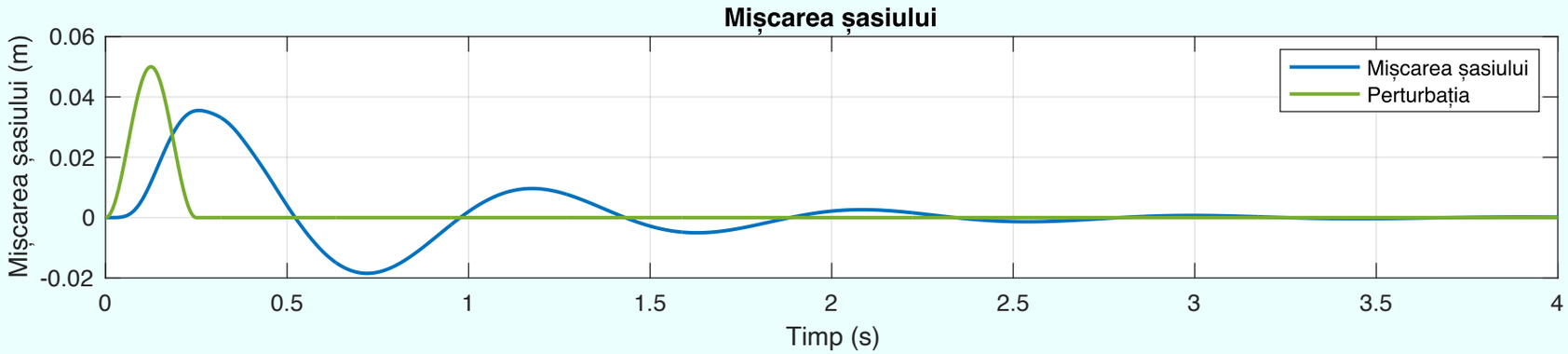
Calcul regulator

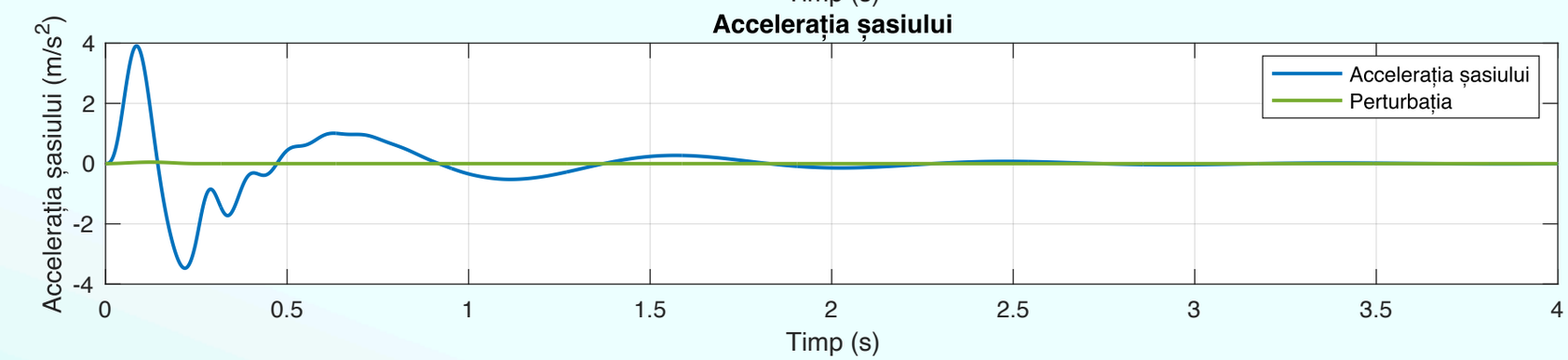
Semnalul de perturbație

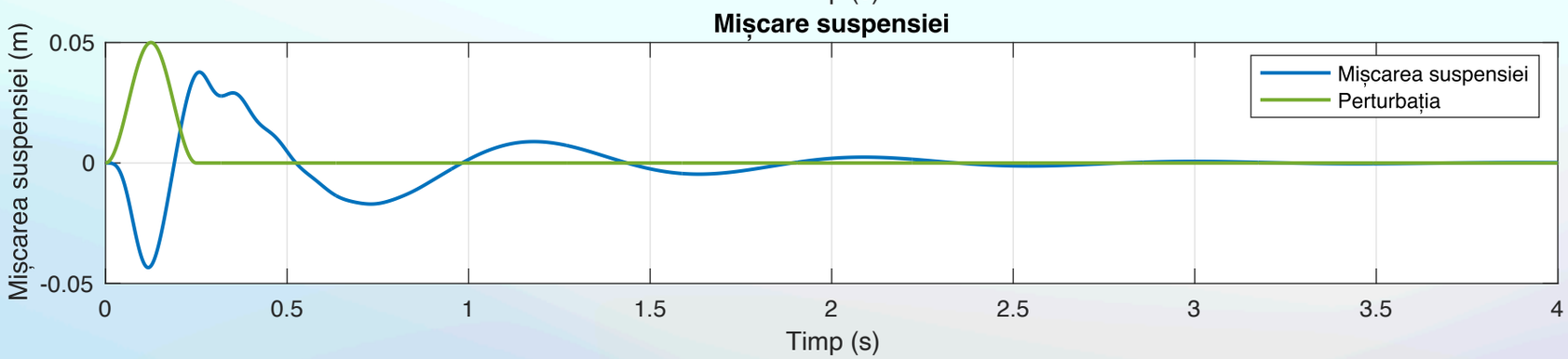


Calcul regulator

Buclă deschisă

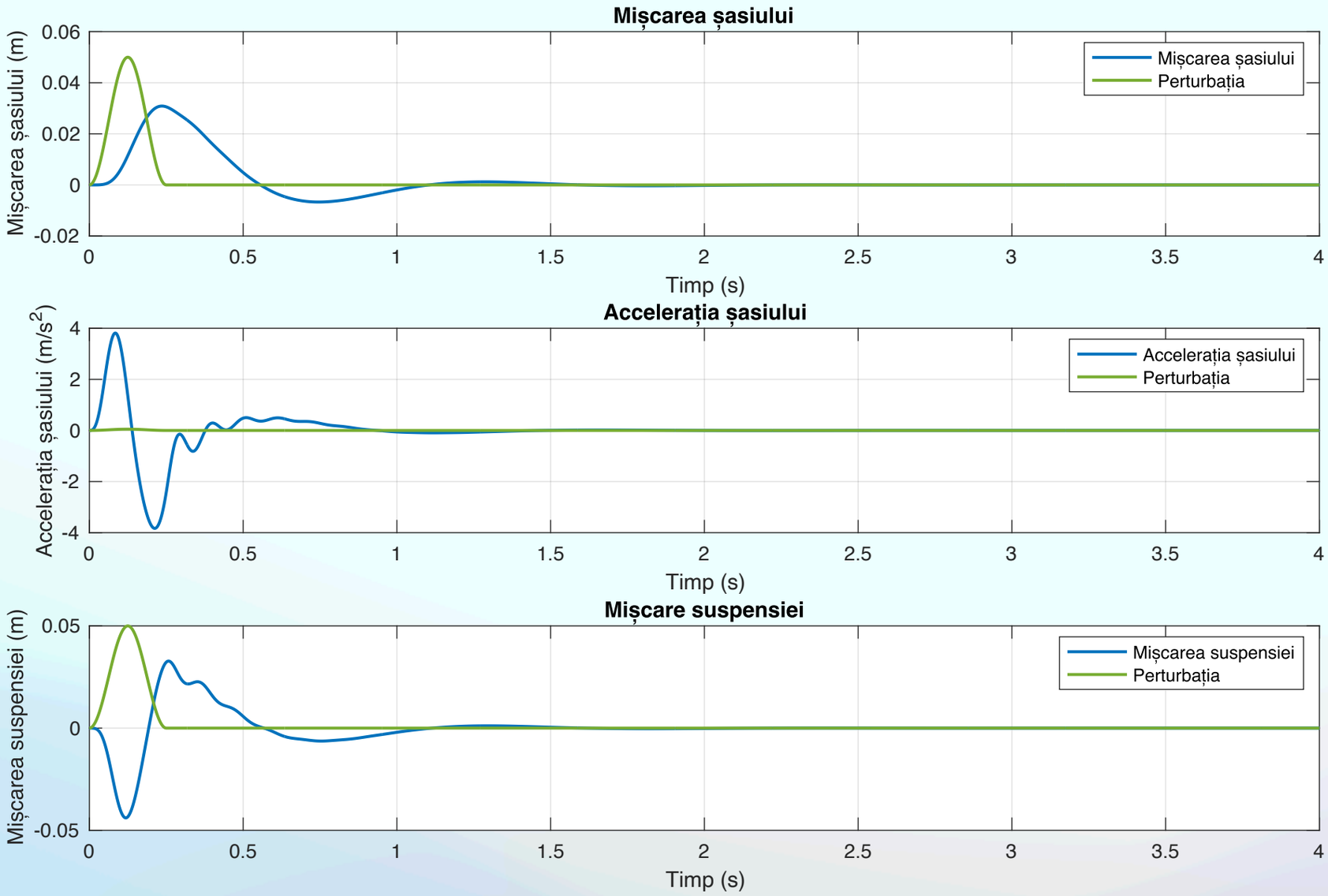






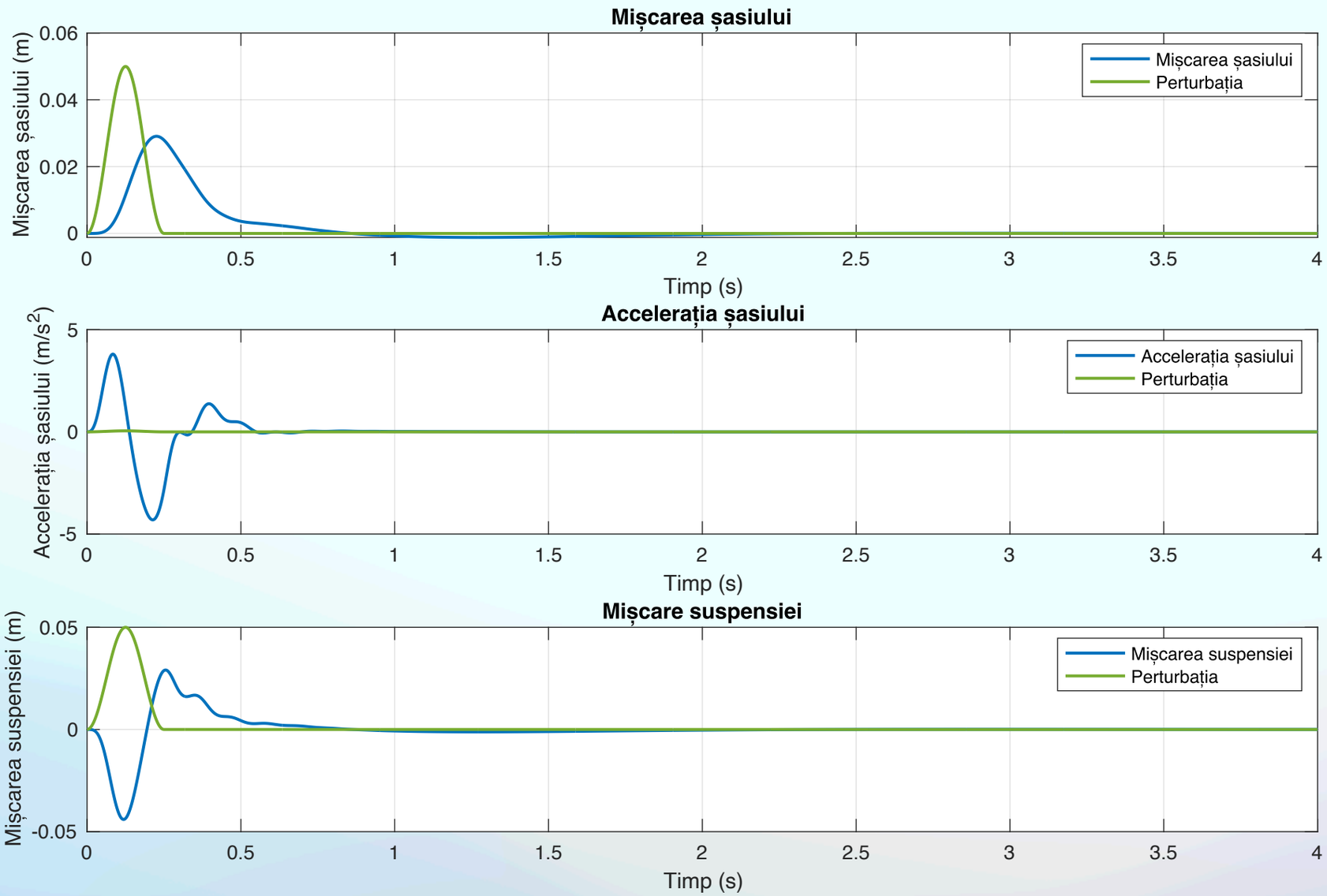
Calcul regulator

Mod Comfort



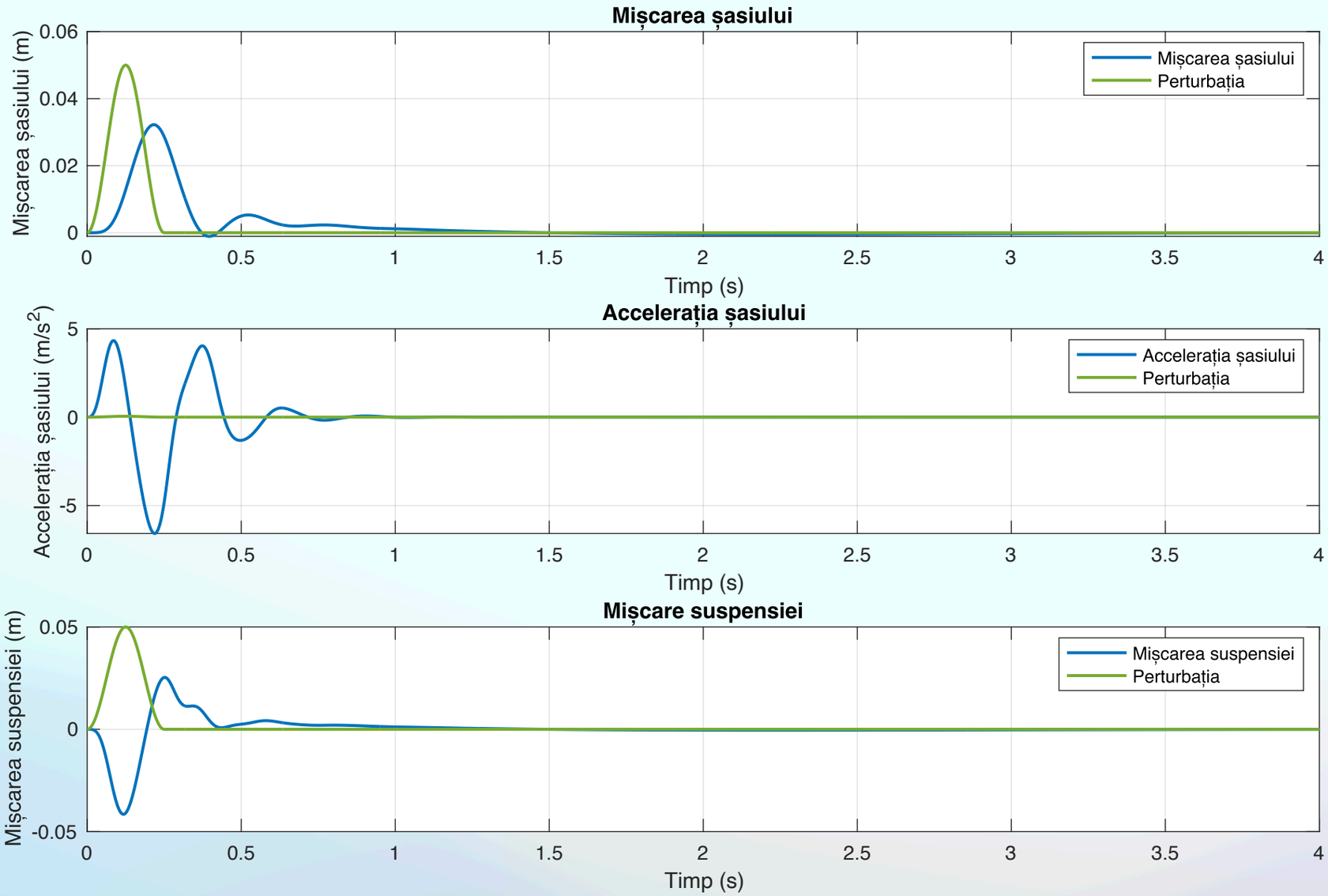
Calcul regulator

Mod Standard



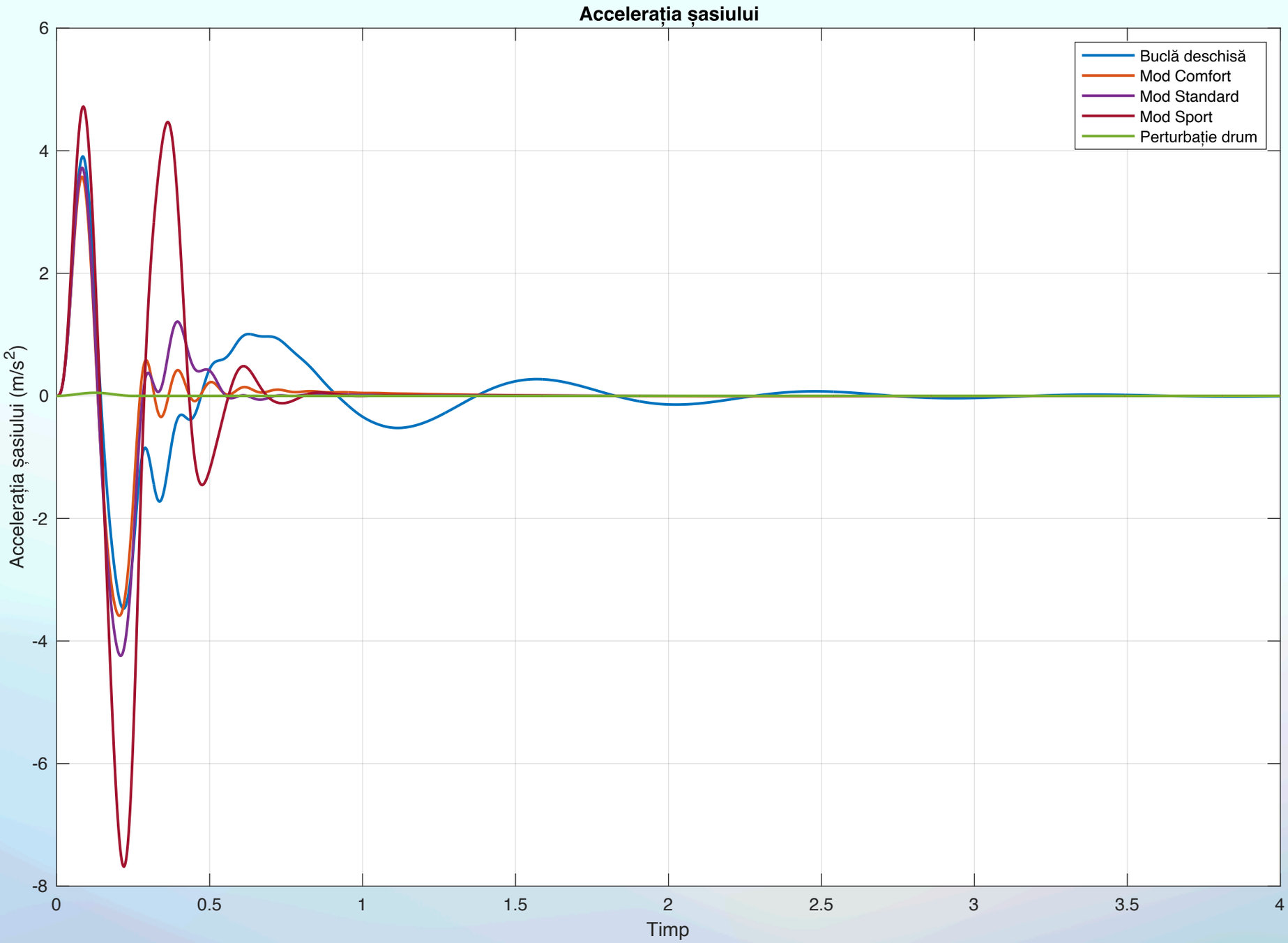
Calcul regulator

Mod Sport



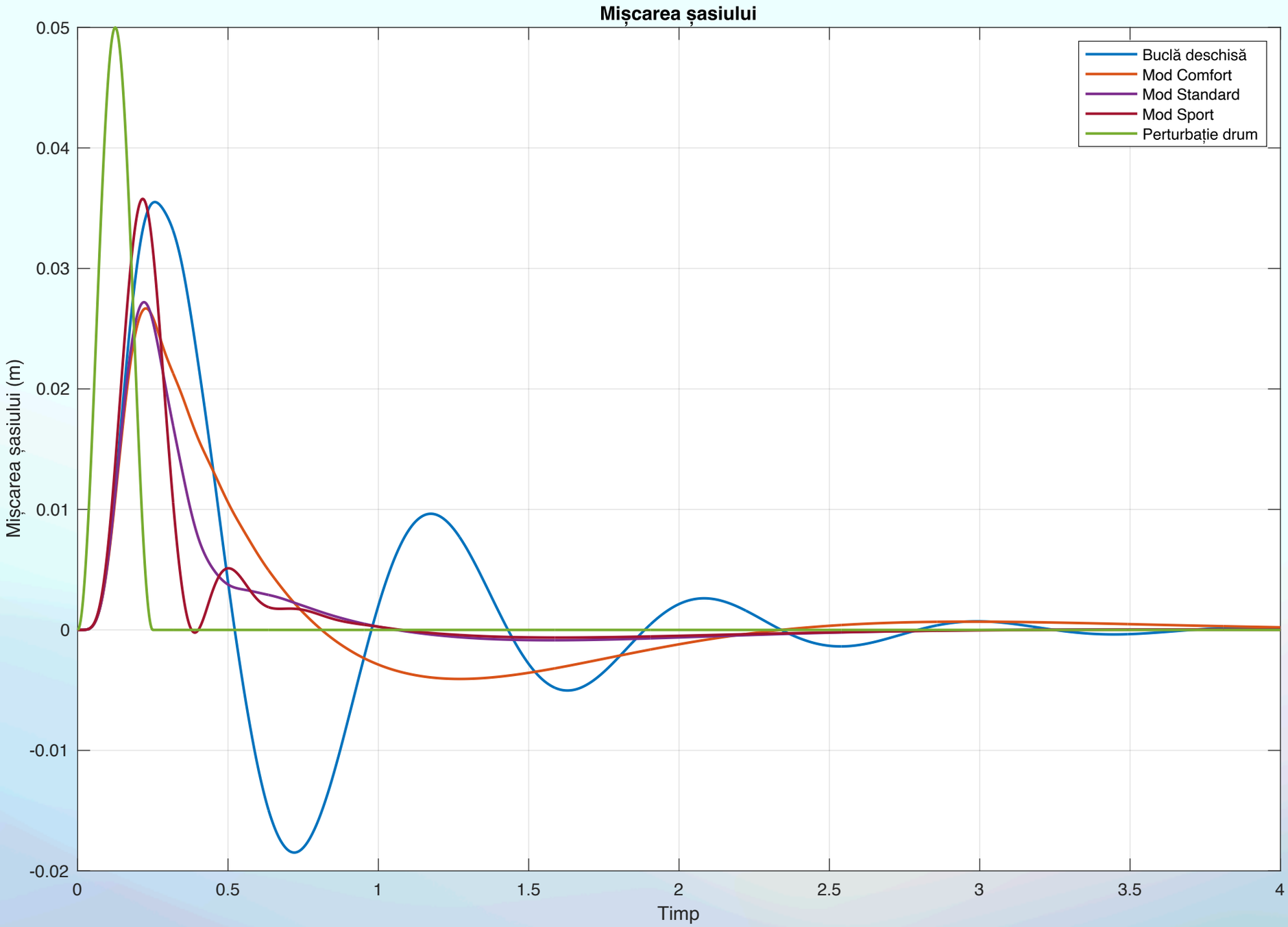
Calcul regulator

Accelerația șasiului (Comparație)



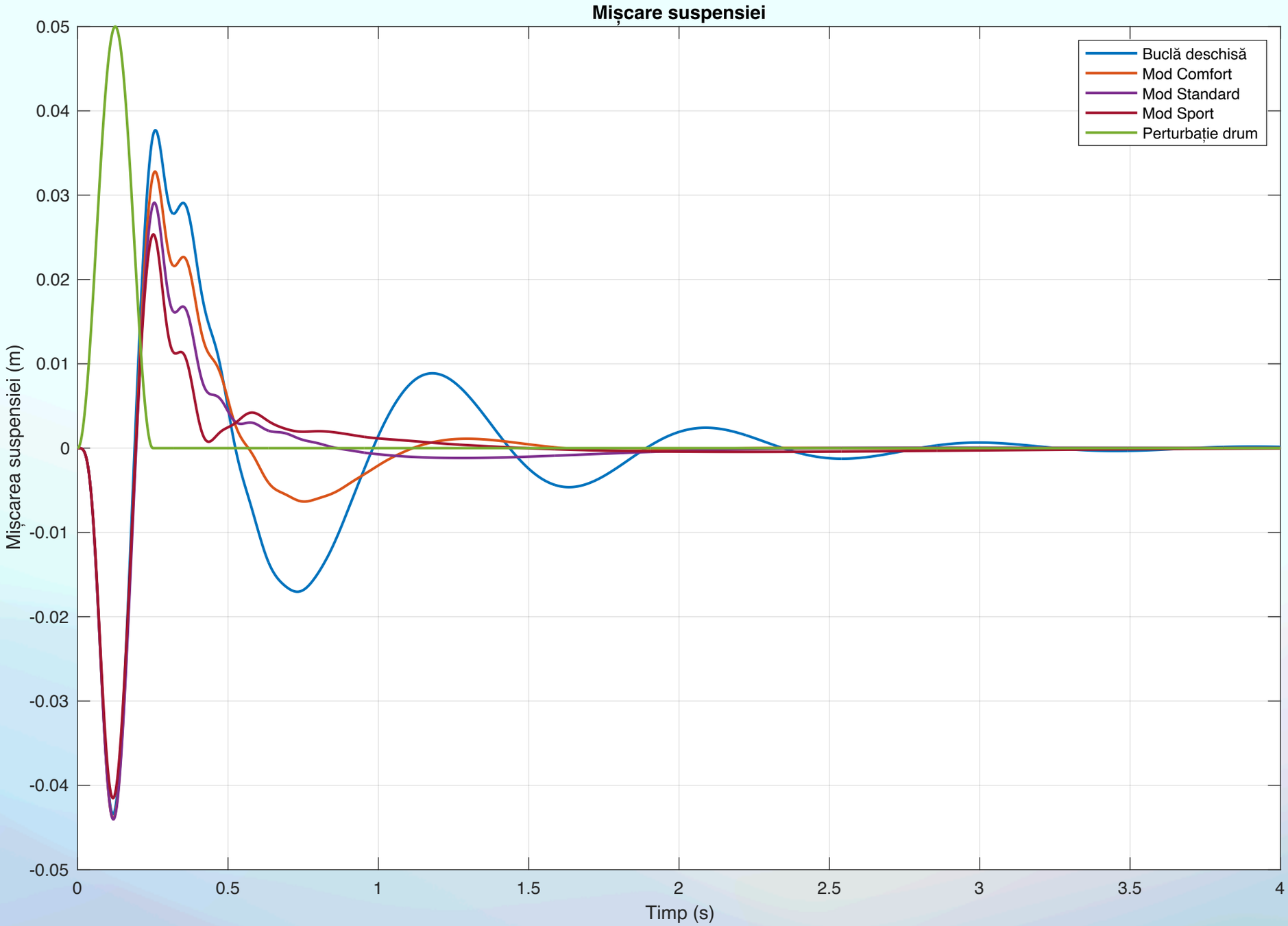
Calcul regulator

Mișcarea șasiului (Comparație)



Calcul regulator

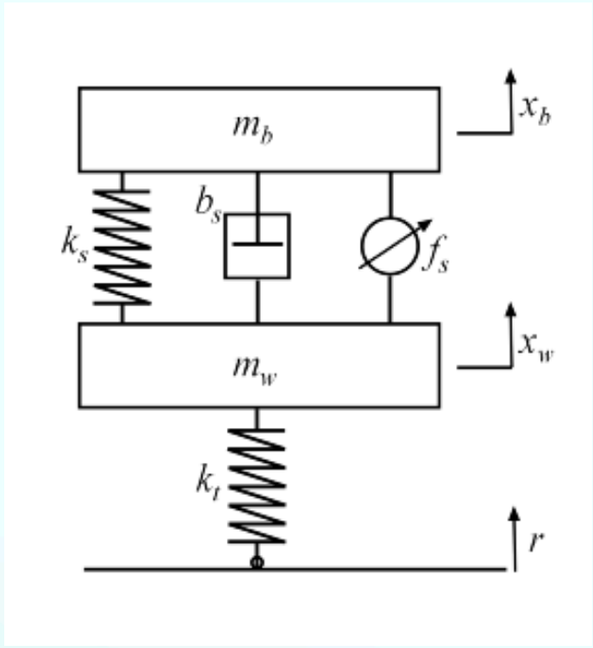
Mișcarea suspensiei (Comparație)



Introducere incertitudini în sistem

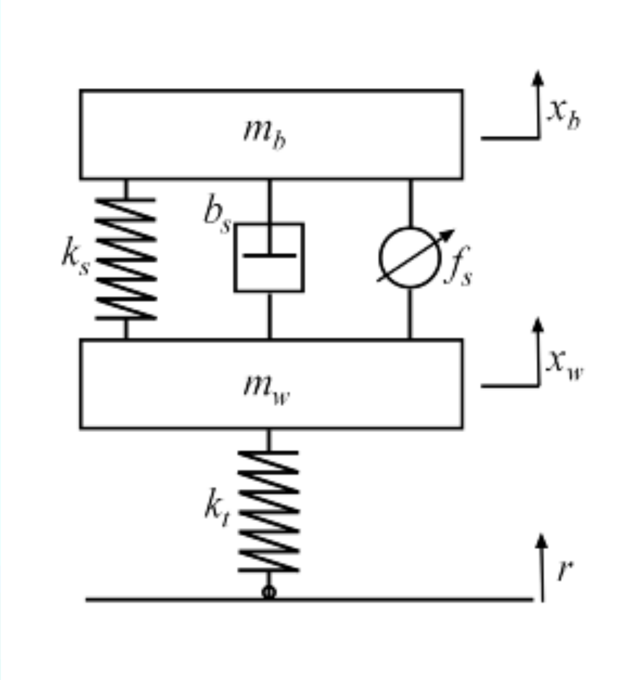
Incertitudini

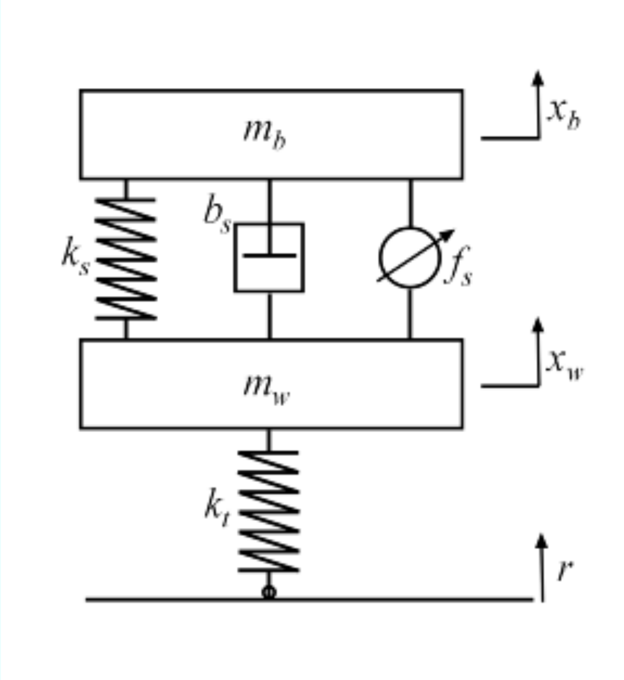
Variații

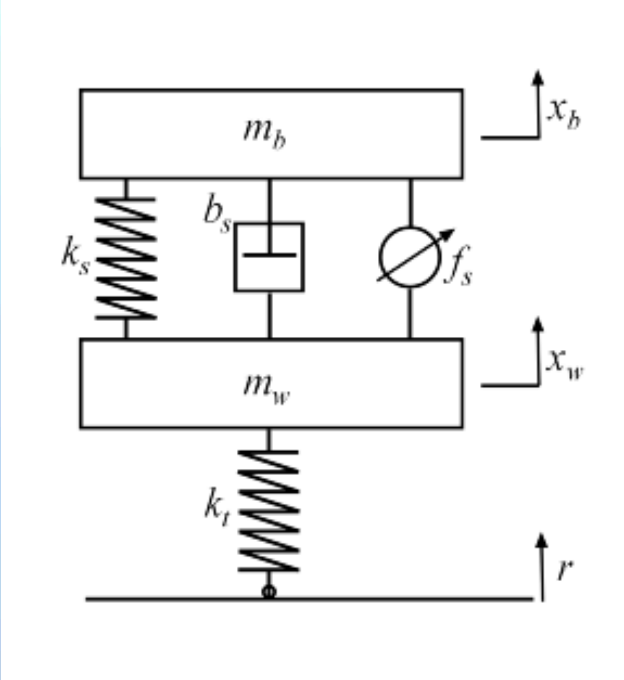


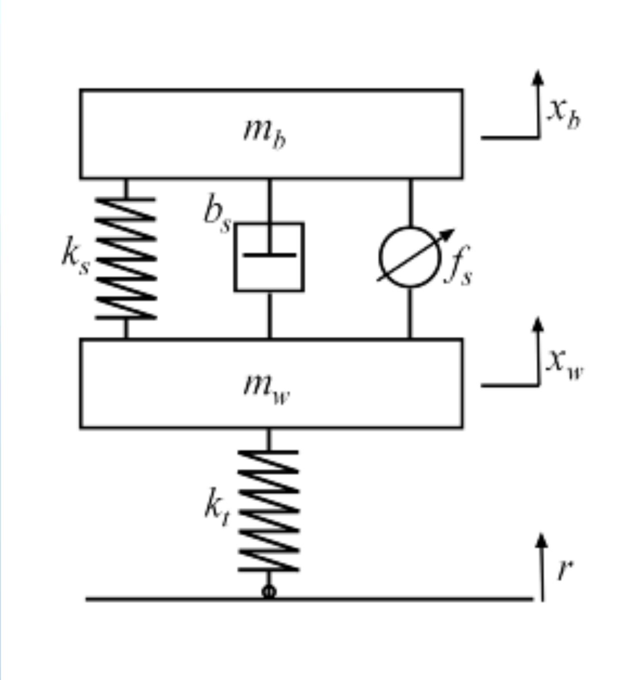
Incertitudini

Variații



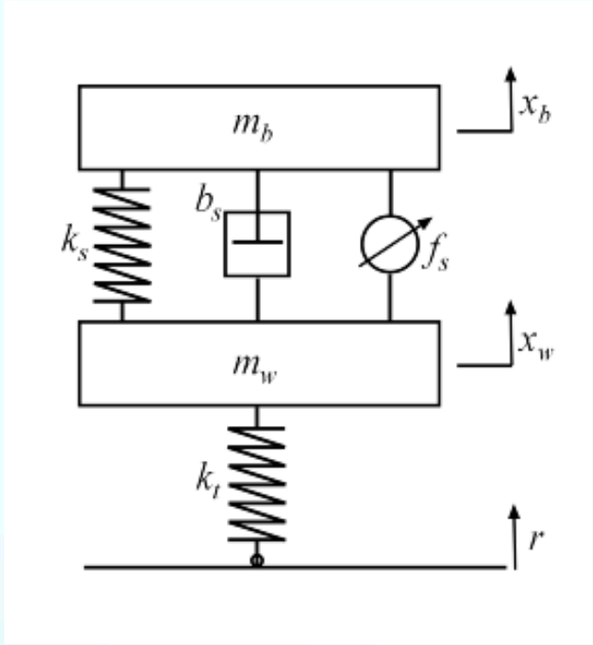


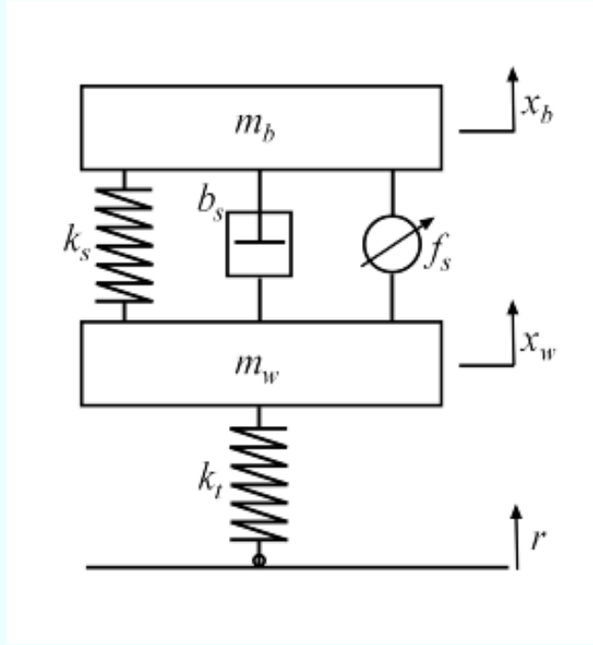




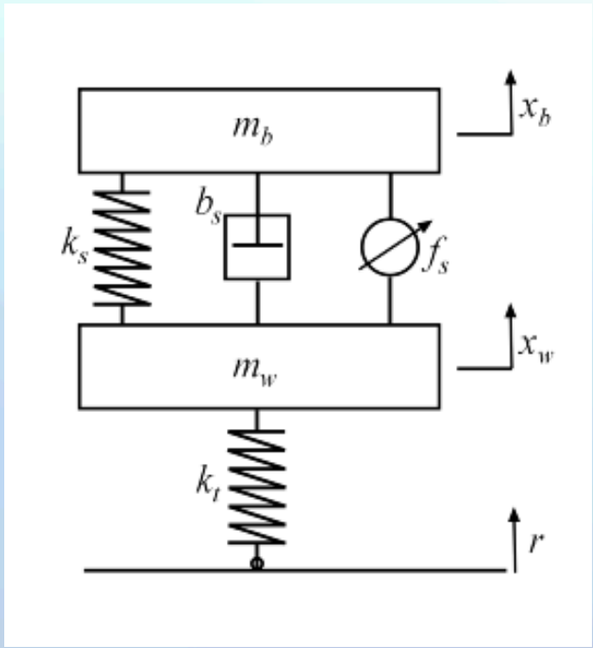
Incertitudini

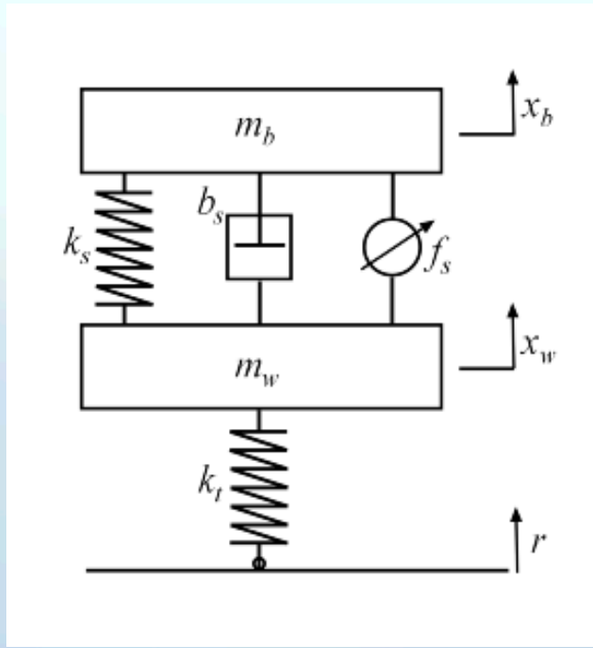
Variații





$$H_{act} \approx \frac{K}{Ts+1}$$

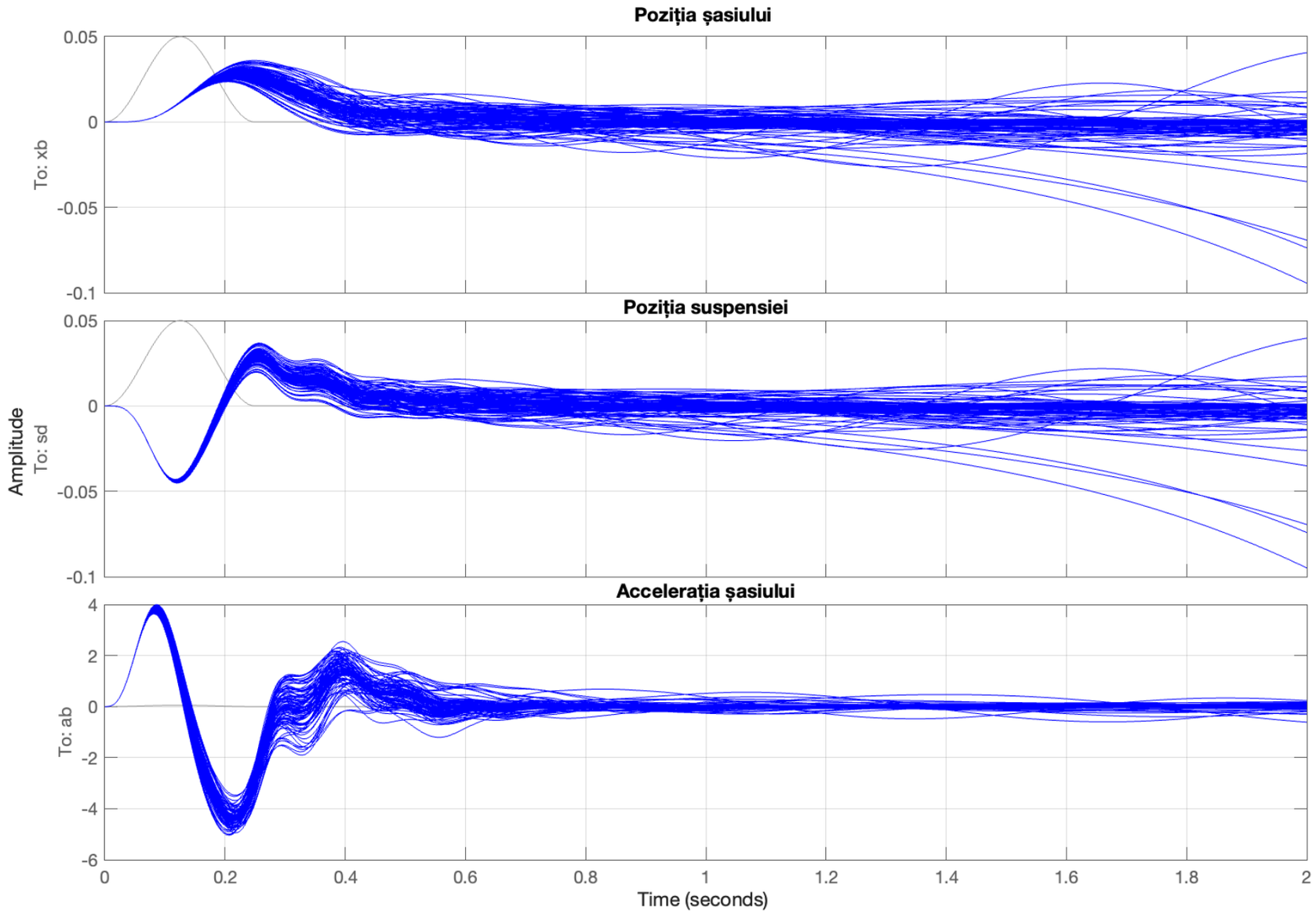




Cum răspunde sistemul la variații?

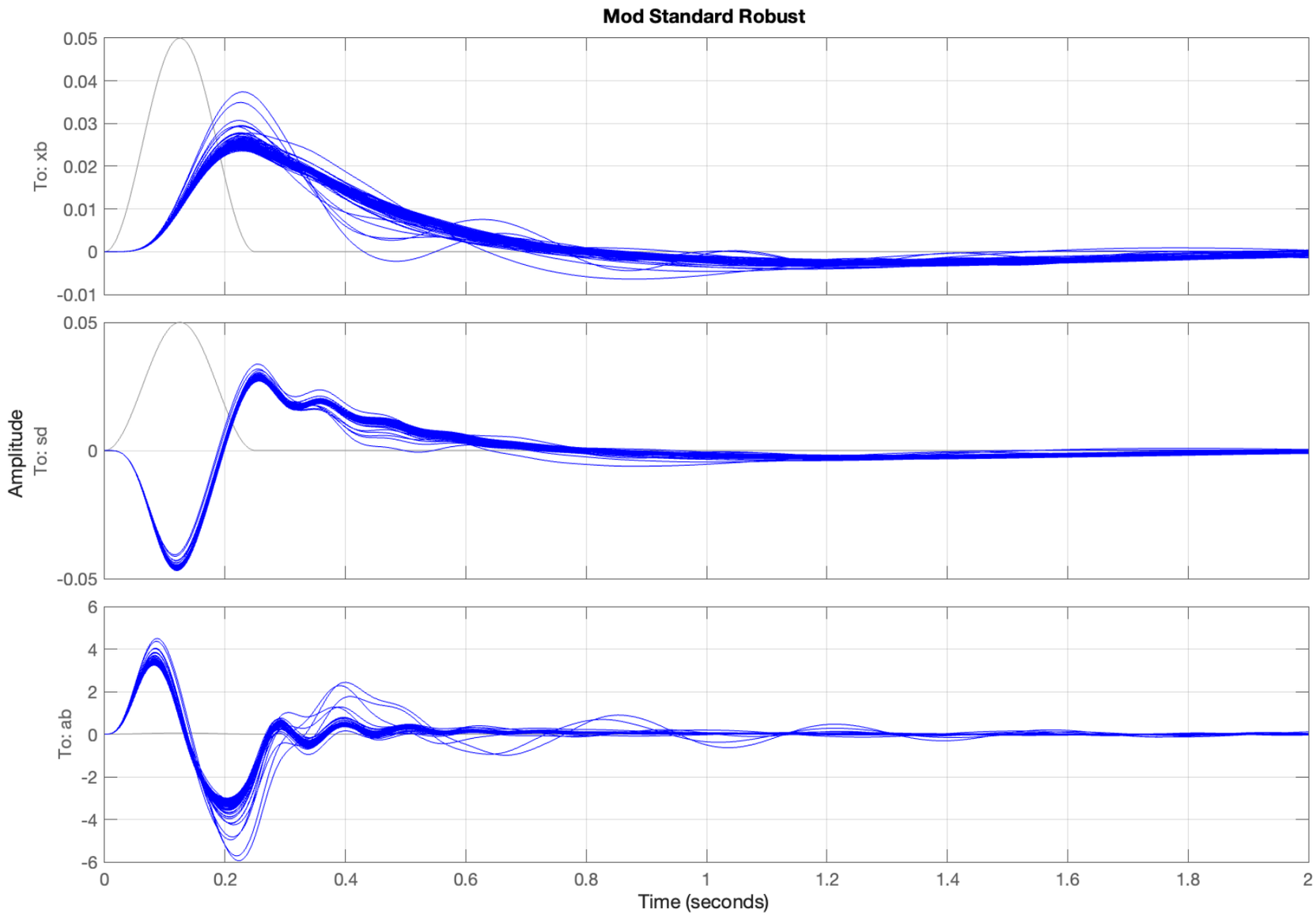
Calcul regulator Mu-Synthesis

Actuator cu incertitudini și regulator H∞ (Mod Standard)



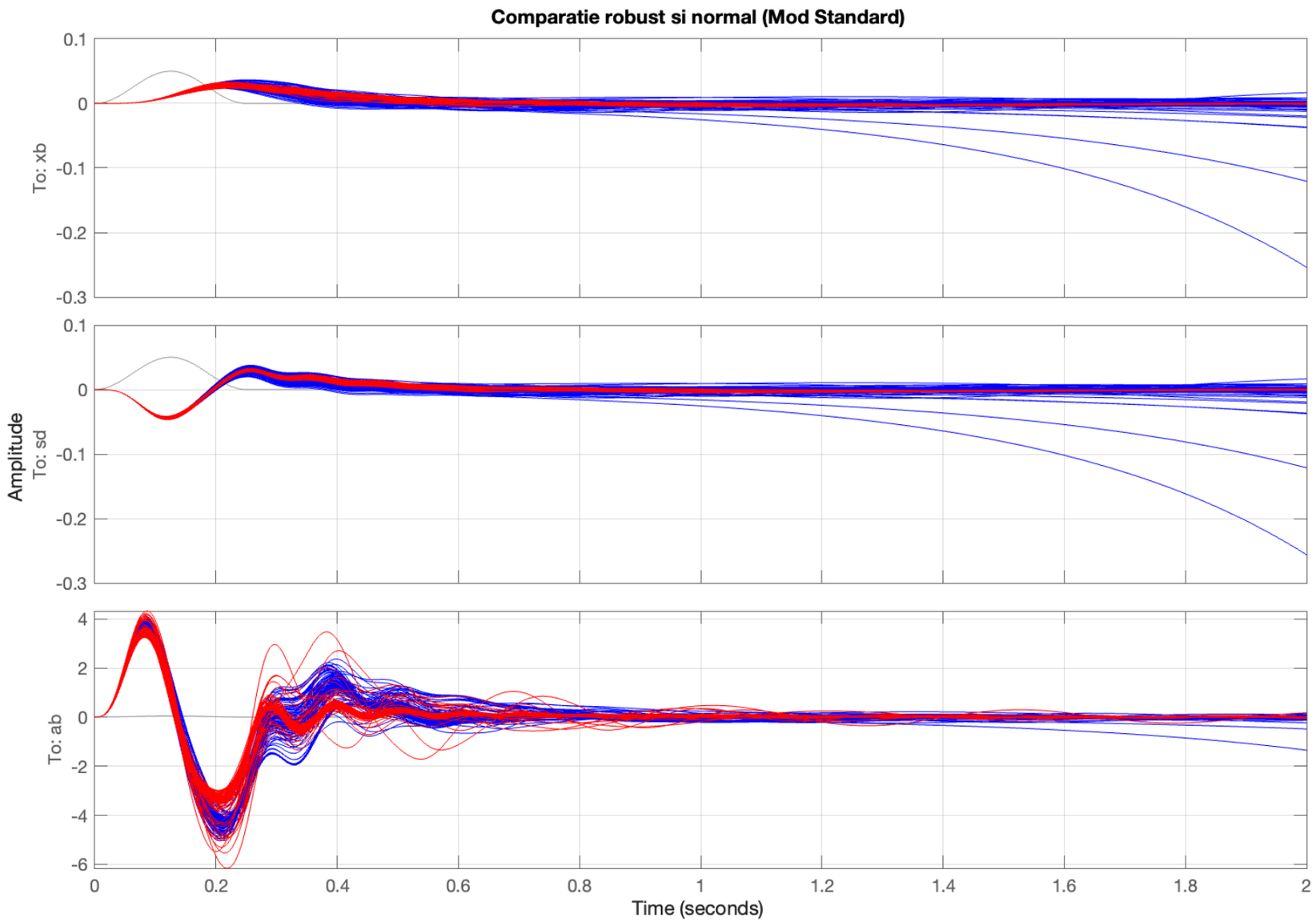
Calcul regulator Mu-Synthesis

Actuator cu incertitudini si regulator μ-Synthesis (Mod Standard)



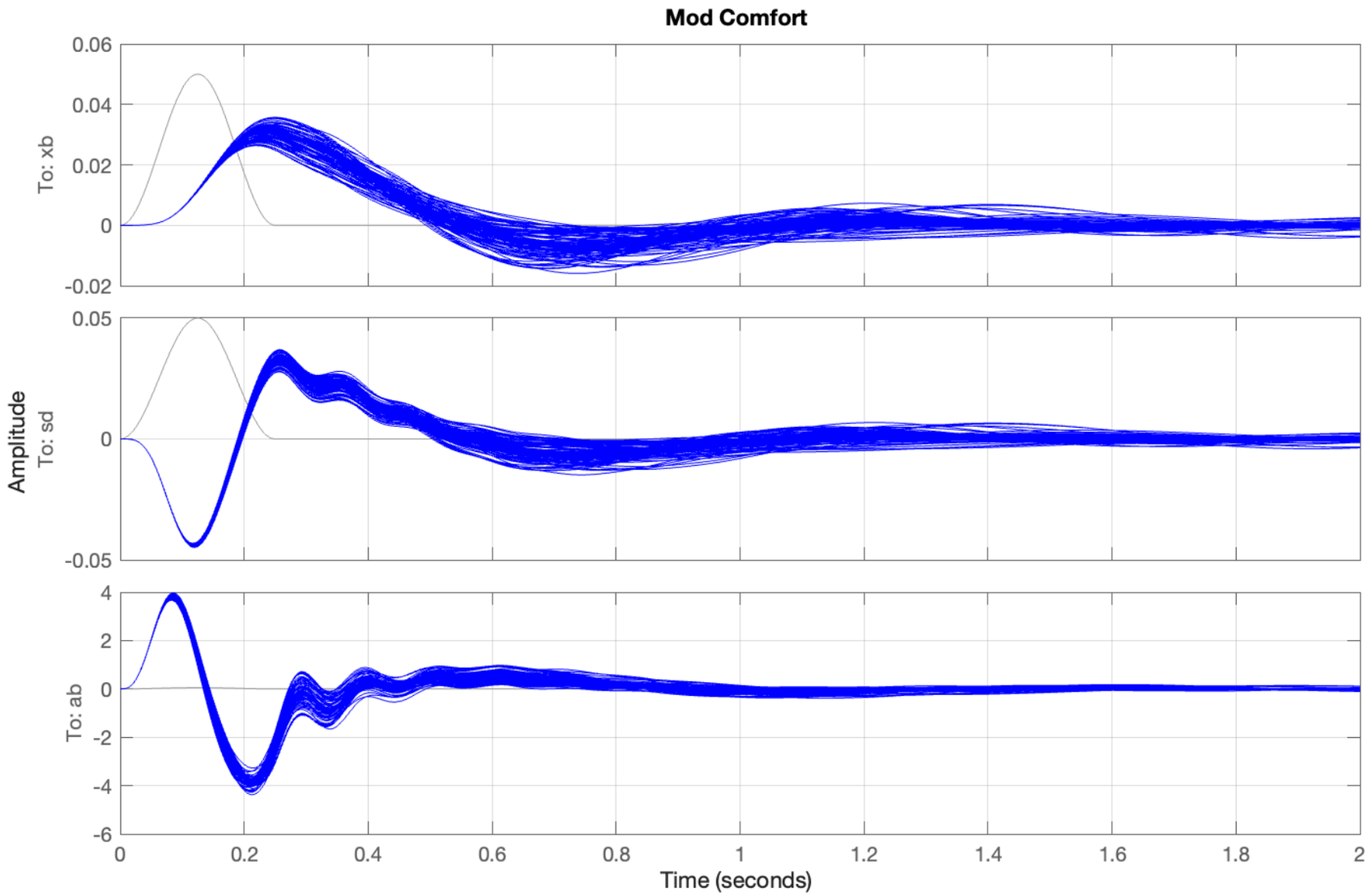
Calcul regulator Mu-Synthesis

Comparație regulator H∞ și regulator μ-Synthesis (Mod Standard)



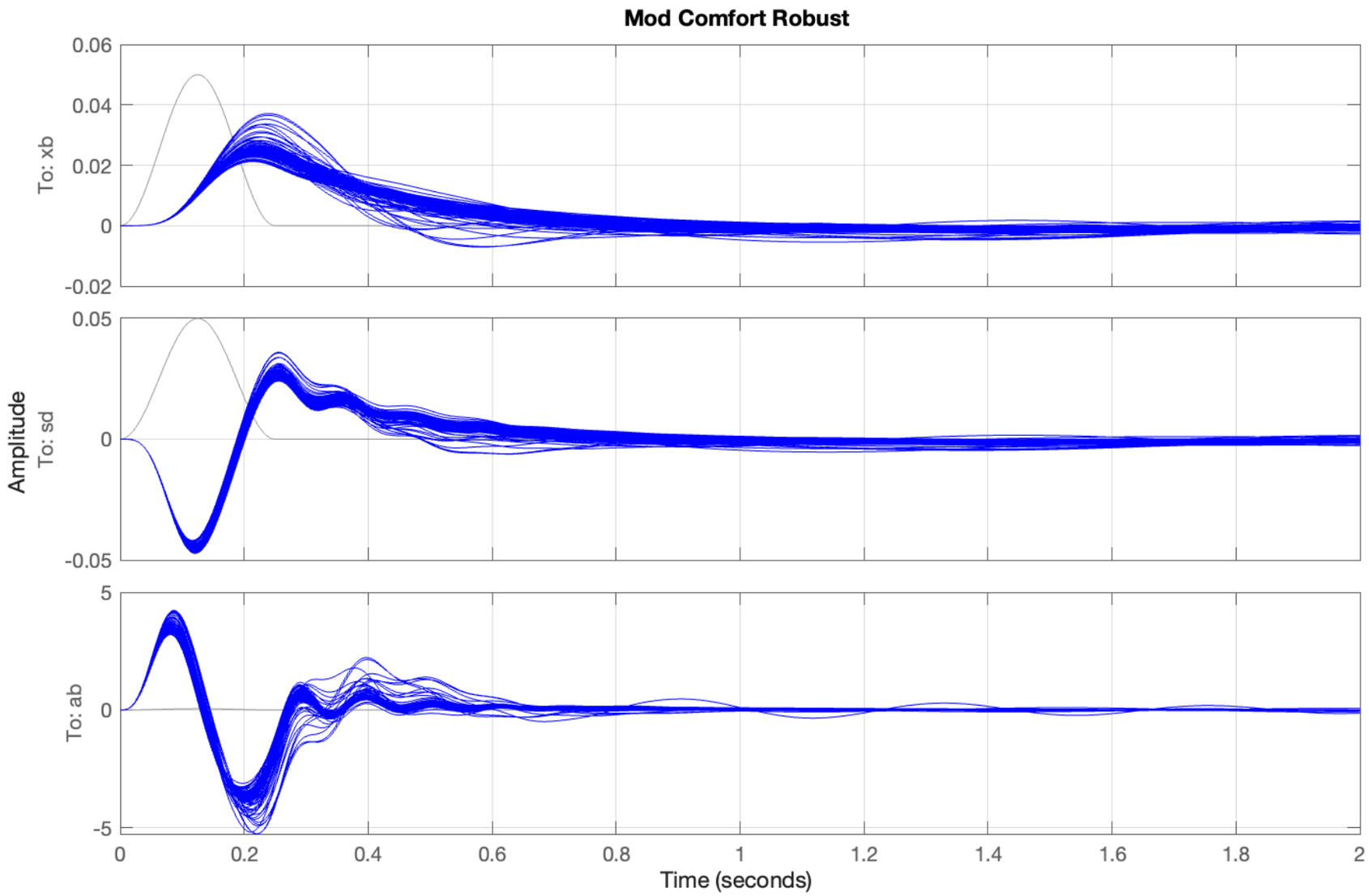
Calcul regulator Mu-Synthesis

Actuator cu incertitudini și regulator H∞ (Mod Comfort)



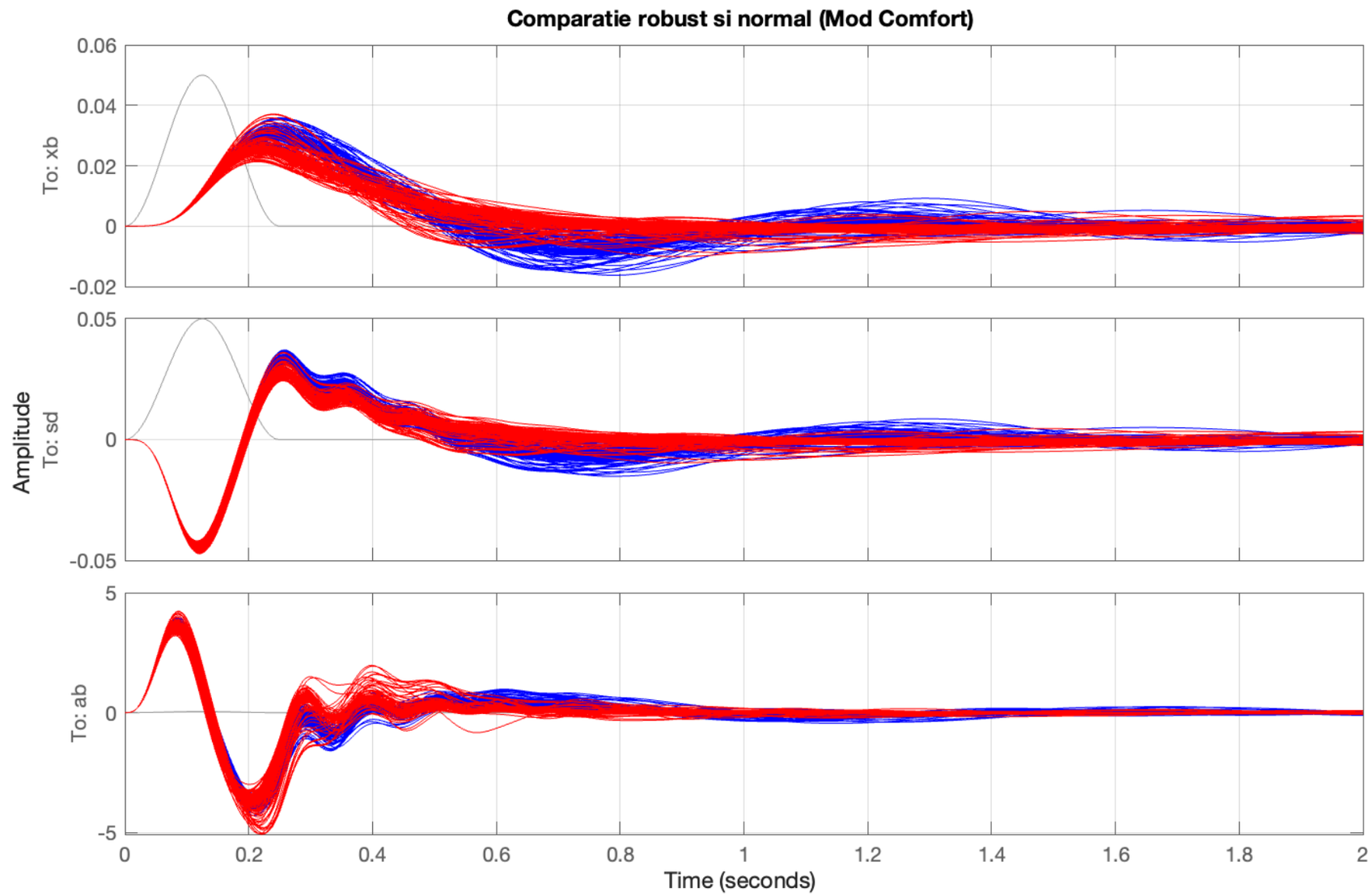
Calcul regulator Mu-Synthesis

Actuator cu incertitudini si regulator μ-Synthesis (Mod Comfort)



Calcul regulator Mu-Synthesis

Comparație regulator H∞ și regulator robust (Mod Comfort)



Concluzii

Vă mulțumesc pentru atenție!