PHILIPS CTT Hogeschool van Utrecht

Systeem en Regeltechniek

FMT / Mechatronica

Deel 1: Inleidende verkenning

Blok 3: De regelaar als veer-demper combinatie

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Cursus Systeem en Regeltechniek

Overzicht

Deel 1	Blok 1.	Inleiding
Wo. 14-04	Blok 2.	Basisprincipes modelvorming massa-veersystemen
	Blok 3.	De regelaar als veer-demper combinatie
Deel 2 *Wo. 21-04*	**Basisbegrippen regeltechniek**	
Deel 3 *Wo. 28-04*	**Vervolg regeltechniek**	
Deel 4 *Wo. 12-05*	**Stabiliteit van regelsystemen**	
Deel 5 *Wo. 19-05*	**Toepassing: PID regelaarontwerp**	
Deel 6 *Wo. 26-05*	**Extra regeltechniek**	

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The controller as spring-damper combination

What does the controller do in a mechatronic system?

?

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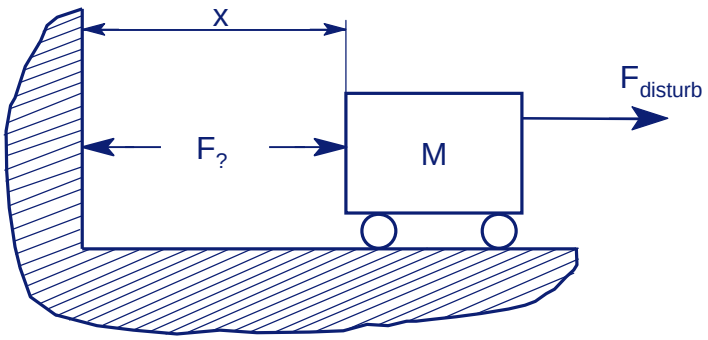
The controller as spring-damper combination

Controlling the position of a mass



Control Objectives:

- Getting there
- Staying there ←

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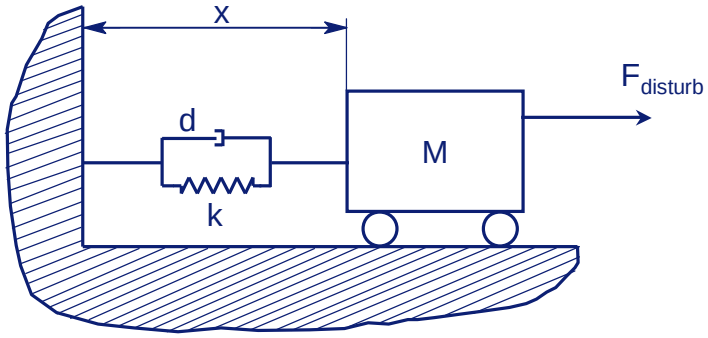
The controller as spring-damper combination

First control objective 'staying there':



Spring-damper force F: $F = -kx - d\dot{x}$

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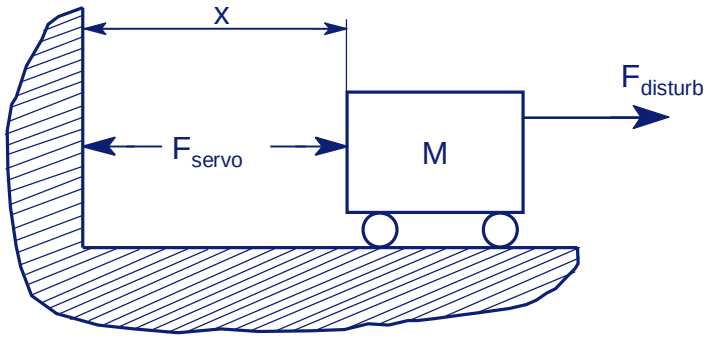
The controller as spring-damper combination

First control objective 'staying there':



Controller: $F_{servo} = -k_p x - k_v \dot{x}$

k_p servo stiffness
k_v servo damping

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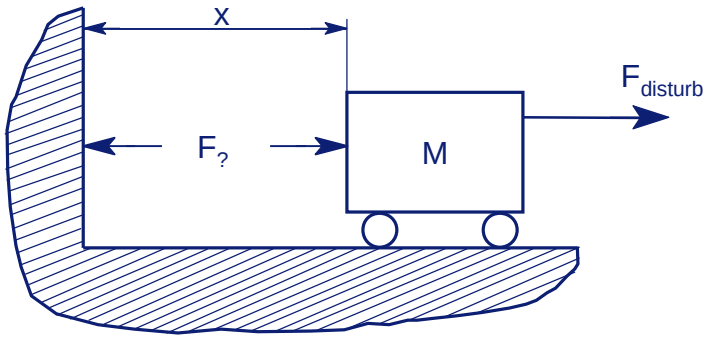
The controller as spring-damper combination

Controlling the position of a mass



Control Objectives:

- Getting there ←
- Staying there

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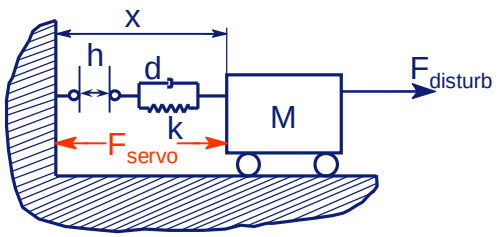
The controller as spring-damper combination

Second control objective 'getting there':



Spring-damper force F: $F = -k(h-x) - d(\dot{h}-\dot{x})$

Controller: $F_{servo} = k_p(x_s - x) + k_v(\dot{x}_s - \dot{x})$

(x_s: setpoint)

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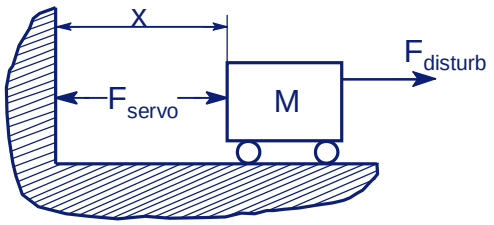
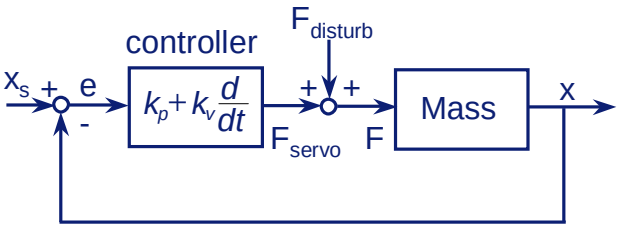
The controller as spring-damper combination

The controlled system



Controller: $F_{servo} = k_p(x_s - x) + k_v(\dot{x}_s - \dot{x})$



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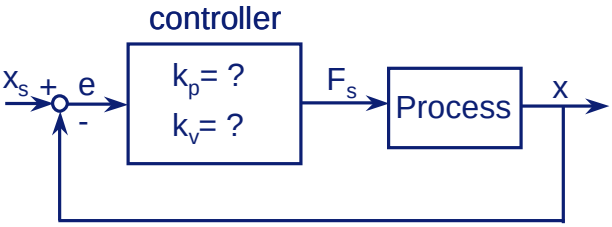
The controller as spring-damper combination

Tuning the K_p / K_v controller



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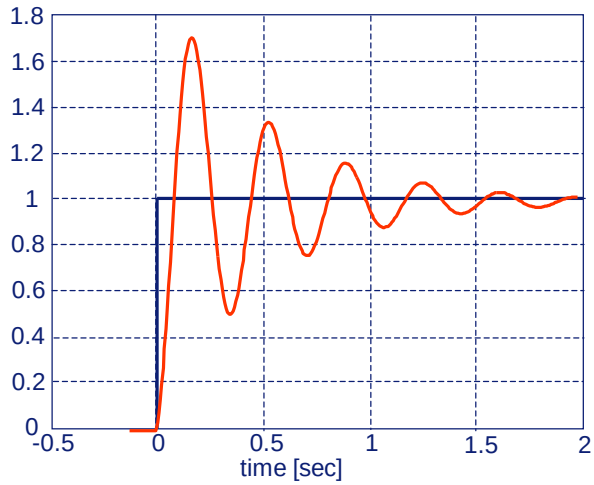
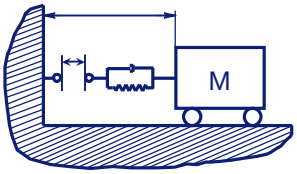
The controller as spring-damper combination

Tuning the K_p / K_v controller

position x [m]

Step response; k_p = 1500 N/m; k_v = 20 Ns/m





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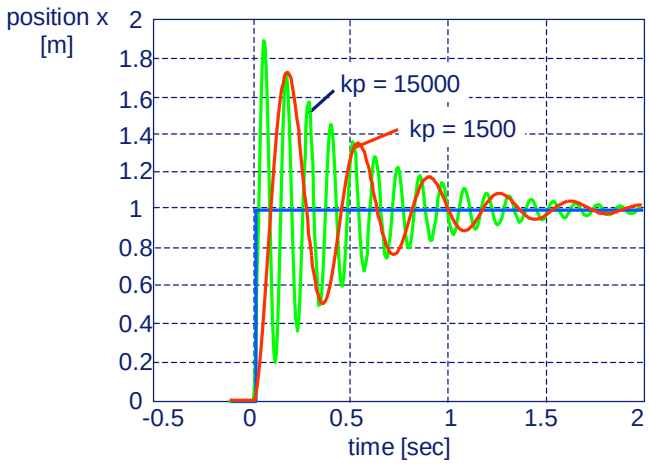
The controller as spring-damper combination

Tuning the K_p / K_v controller

Step response; k_p = 15000 / 1500 N/m; k_v = 20 Ns/m



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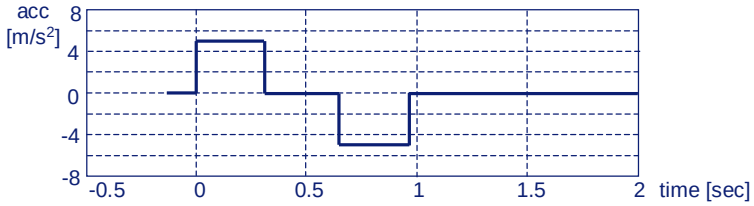
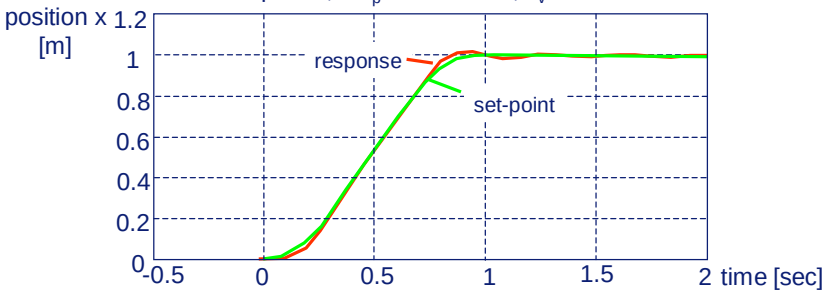
The controller as spring-damper combination

Tuning the K_p / K_v controller

Acceleration profile (v_max = 1.5 m/s)



Time response; k_p = 1500 N/m; k_v = 20 Ns/m



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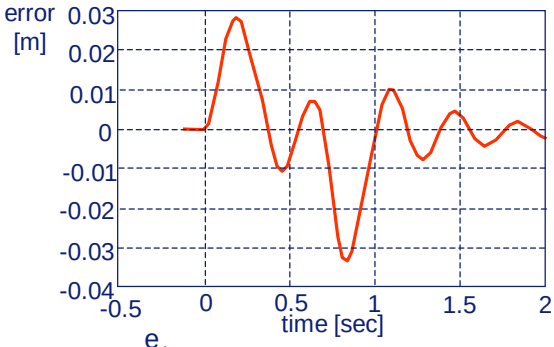
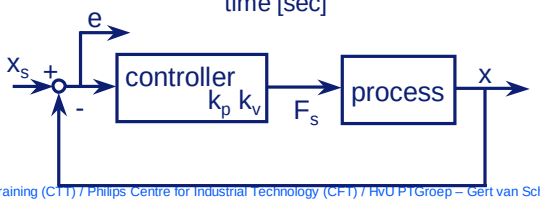
The controller as spring-damper combination

Tuning the K_p / K_v controller

Time response; k_p = 1500 N/m; k_v = 20 Ns/m





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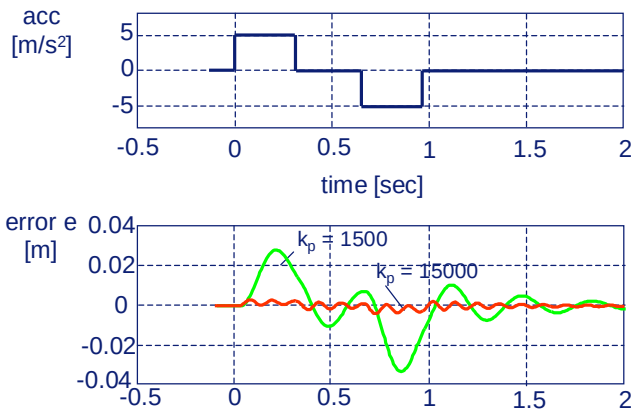
Tuning the K_p / K_v controller

Time response; k_p = 15000 / 1500 N/m; k_v = 20 Ns/m



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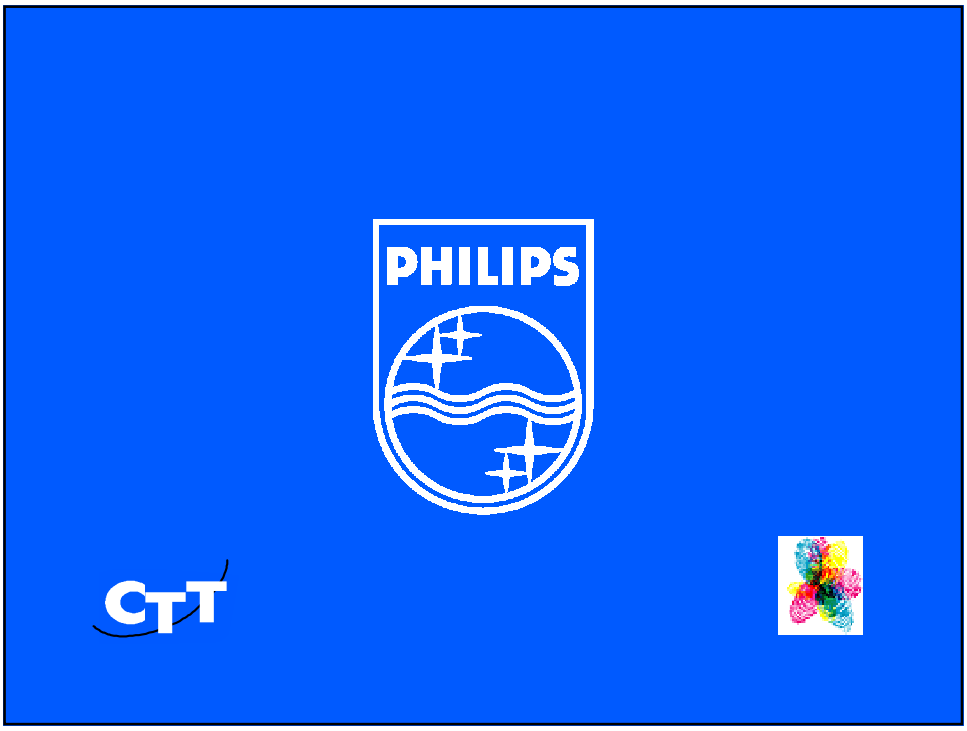
The controller as spring-damper combination

Summary

- Controlling the position of a mass:
  - Staying there
  - Getting there
- K_p controller as spring (reduce error)
- K_v controller as damper (stability)
- Setpoint to get there

Exercise with 20-sim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