Water Tank

Control of Laboratory Model

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Outline

What is the Water Tank V3?

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Figure:
[www.inspired-training.com]

Not a "water-tank"!

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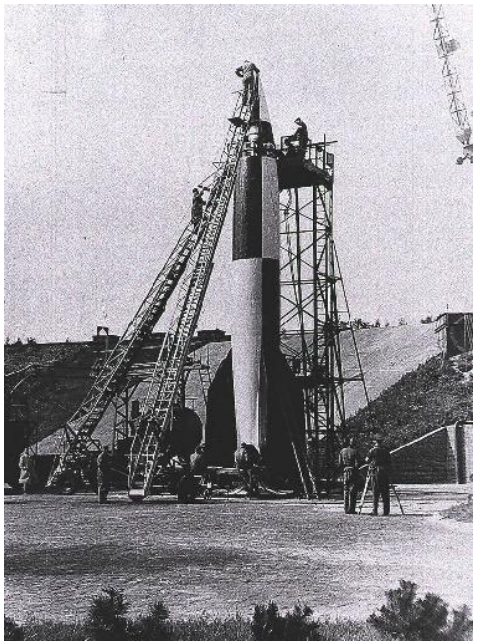

Figure: [www.grc.nasa.gov]

Not a successor of V2!

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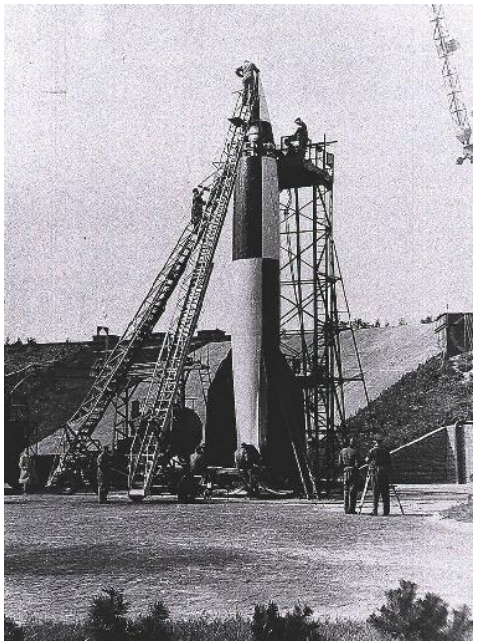

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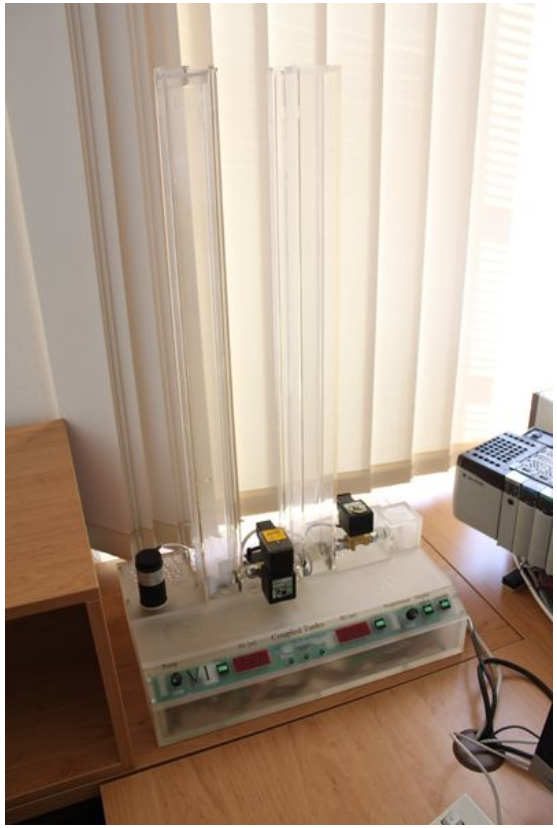

Figure: Water Tank

But 3rd model of water tank in laboratory "Allen Bradley"...

Introduction: model description

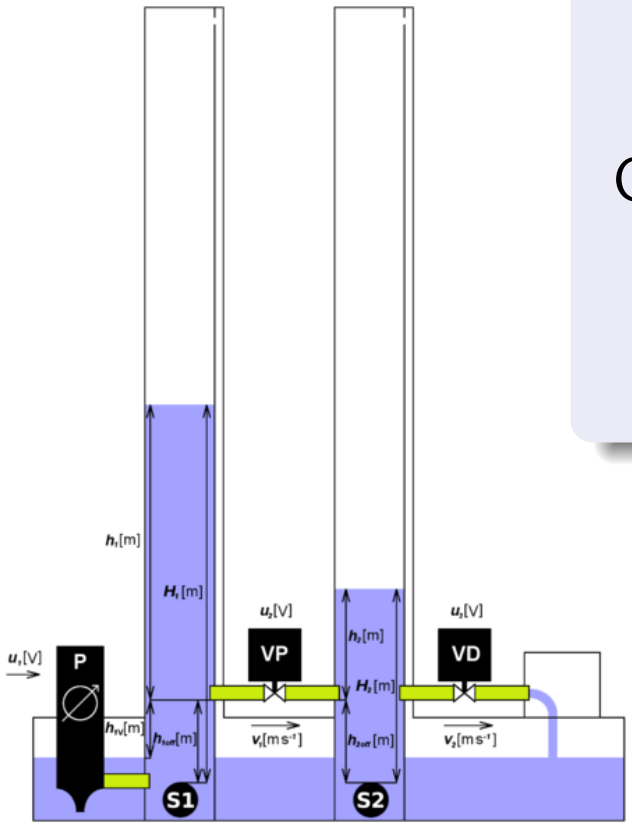

Figure: Water Tank - schema

Transfer function

$$G(s) = \frac{0.01145}{s^4 + 2.94\,s^3 + 4.34\,s^2 + 0.49\,s + 0.01} \qquad (1)$$

Operating point:

$$u_0 = 0.5\,V \qquad h_{02} = 14.13\,cm \qquad (2)$$

- two water tanks
- two valves - digital and proportional (both opened)
- **input: voltage** in pump
- **output: height of water level** in 2nd tank

Goals: design controller

Used methods

Manual tuning, *Ziegler-Nichols*, *Frequency methods*, *Geometric Root Locus Method*, *Dominant poles*. We designed over **20 regulators**.

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Reaching operating point

Control from 0 *cm* to operating point (14.41 *cm*).

The best result

PID, designed by GRL

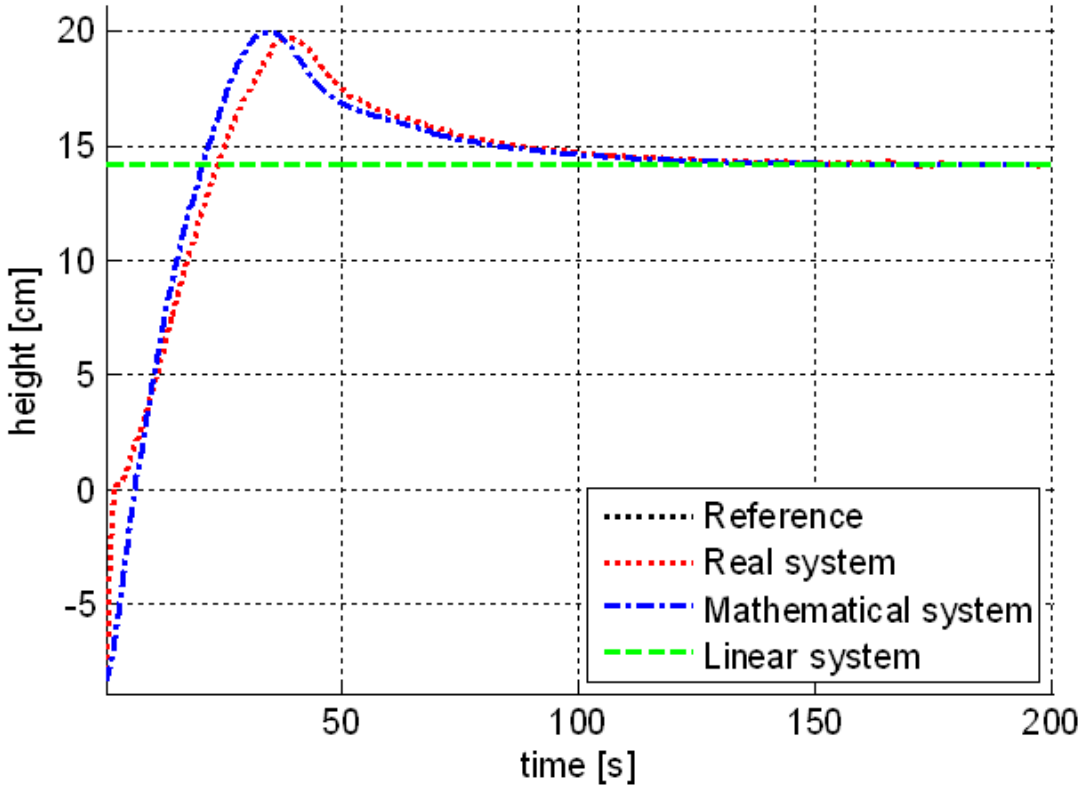

Figure: PID, reaching operating point

Control requirements and designed regulator I

I) error 5 %

Error from settling value should not exceeded 5 %

The best result

PD, frequency method

Known issues

Setting operating point.

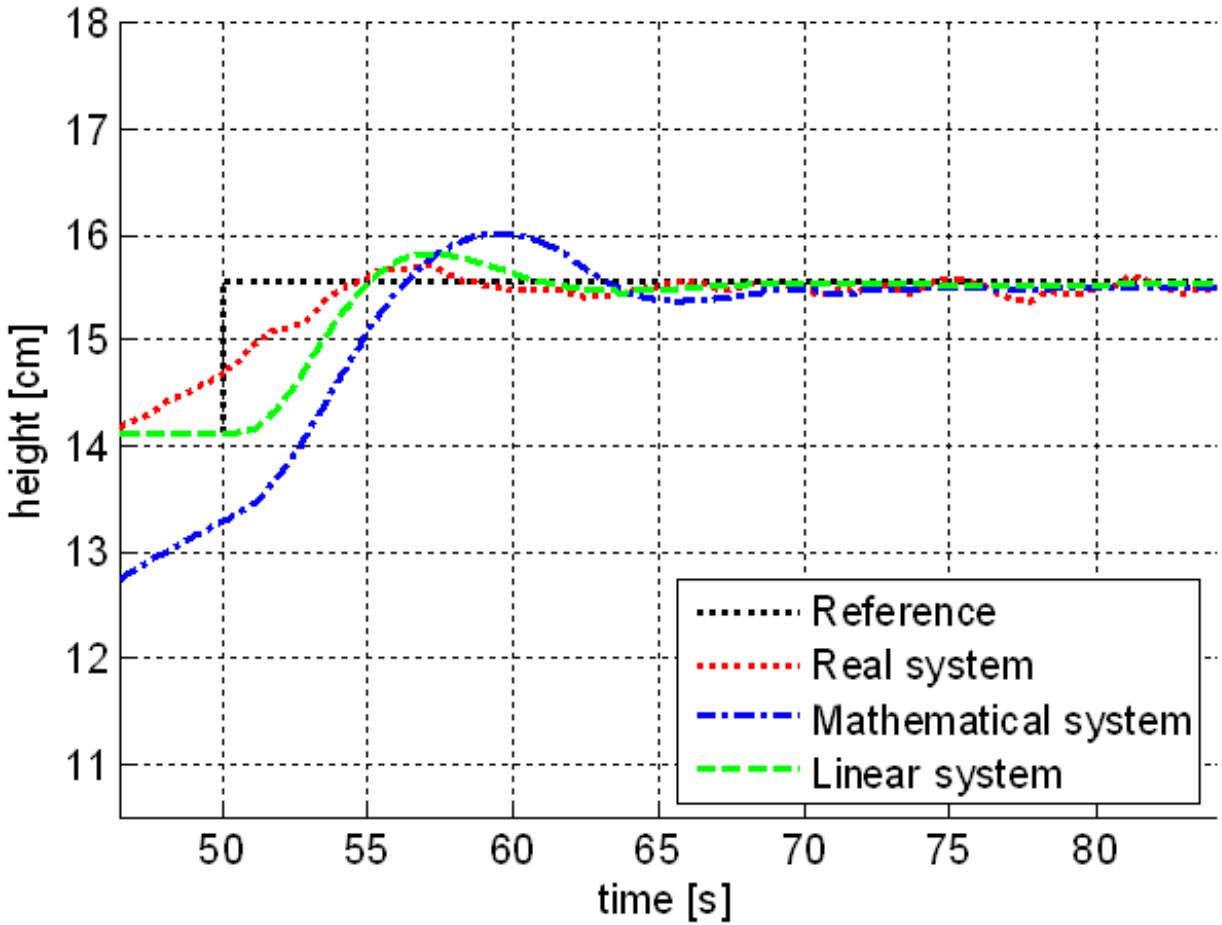

Figure: PD and real model, step 10 % from operating point

P [–]	I [–]	D [–]	GM [dB]	PM [°]	OS [%]	Err. [%]	$T_s[s]$
63.021	0	128.6142	4.61	70.12	35.89	1.64	**14.55**

Control requirements and designed regulator II

II) OS 30 %, error 0 %

Overshoot 30 % and error from settling value should not exceeded 0 %

The best result

PID, frequency method

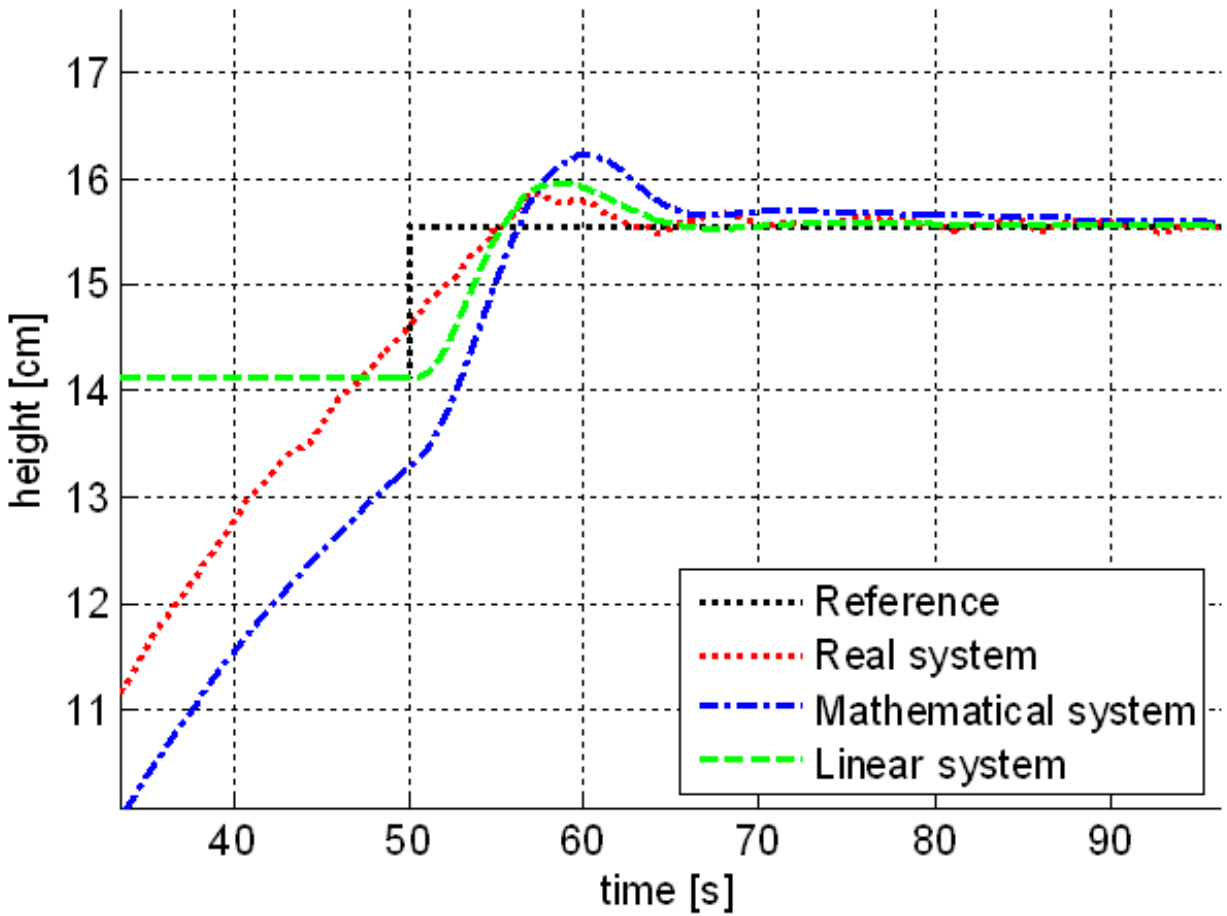

Figure: PID and real model, step 10 % from operating point

P [–]	I [–]	D [–]	GM [dB]	PM [°]	OS [%]	Err. [%]	$T_s[s]$
46.3316	0.48	103.3865	6.27	79.7	30	0	**18.13**

Demonstration on the real model

Bubble...

References


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Source of picture 3 and 4.

Thank you for your attention!

Acknowledgement

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