Design of control systems

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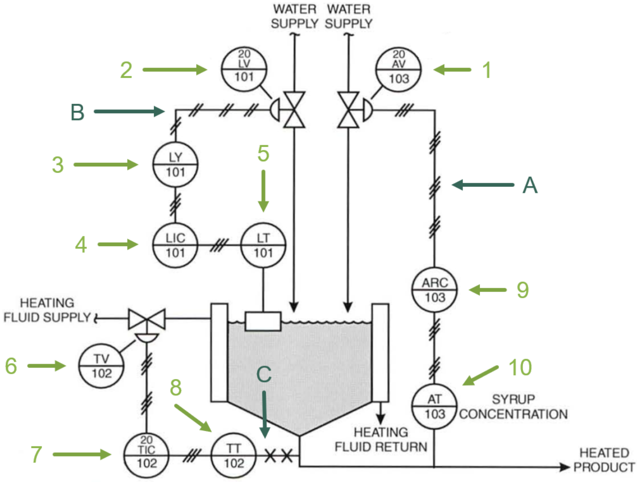
September 19, 2022

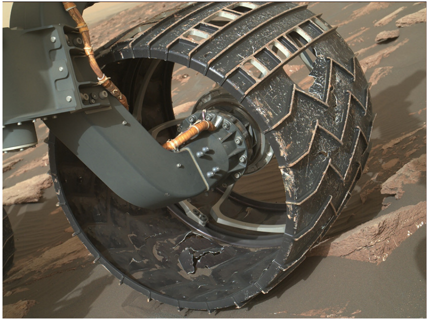
Feedback control systems are ubiquitous



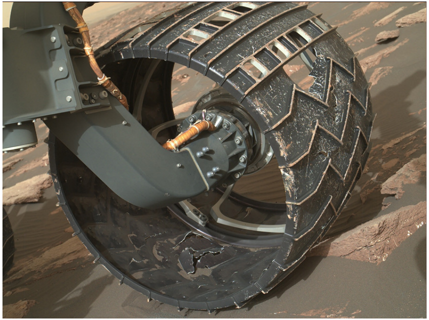
Feedback control systems

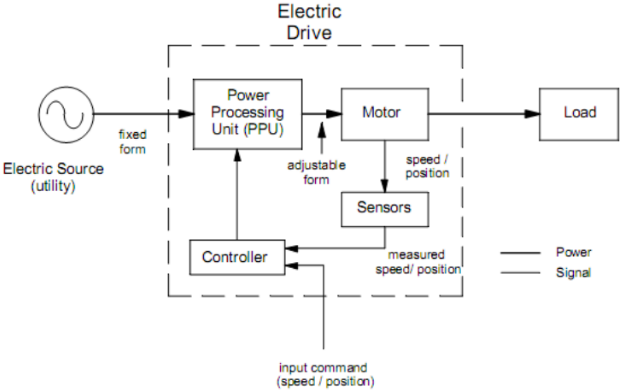
The problem situation

Feedback control system

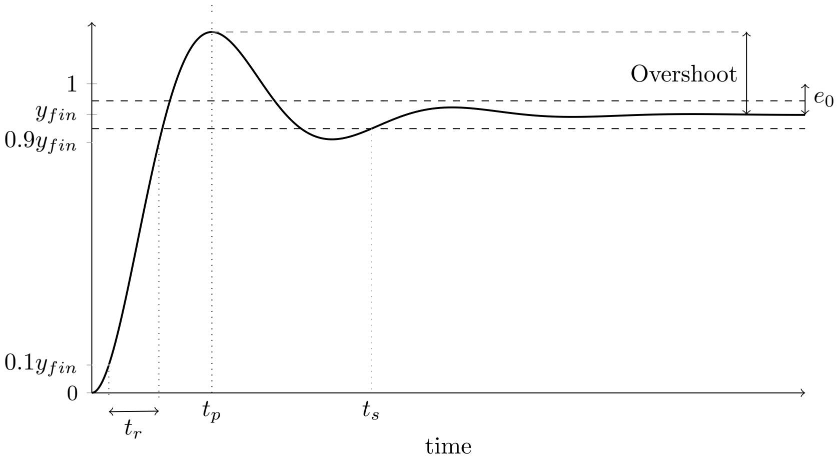


Feedback control system





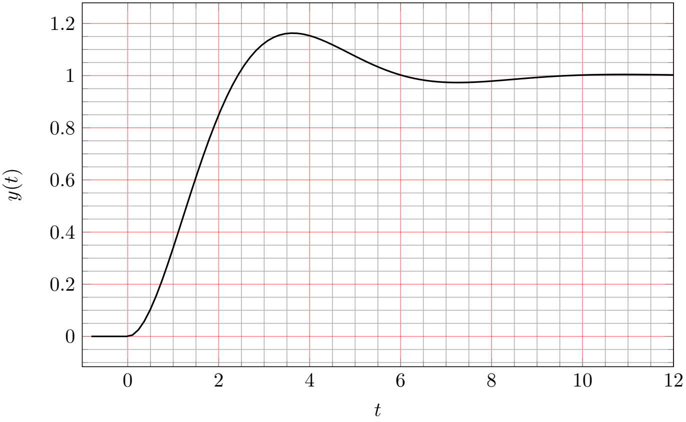
Performance requirements - time domain



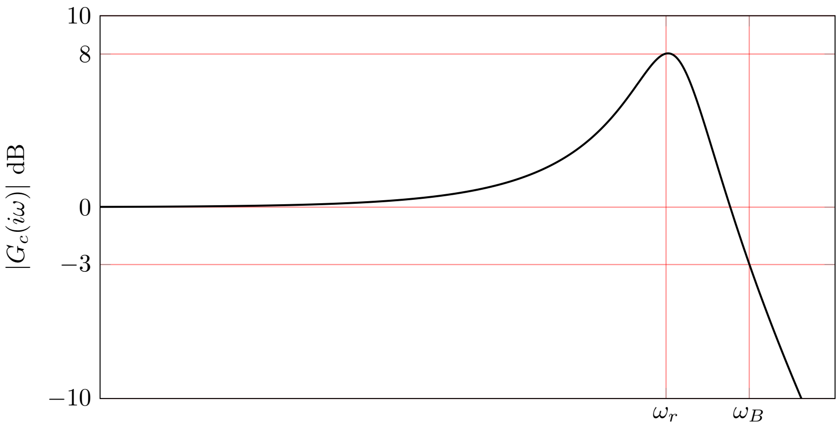
Performance requirements - time domain

Activity Does the system satisfy the requirements?

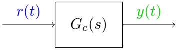
Rise time	< 1.5s
Overshoot	$< 18\%$

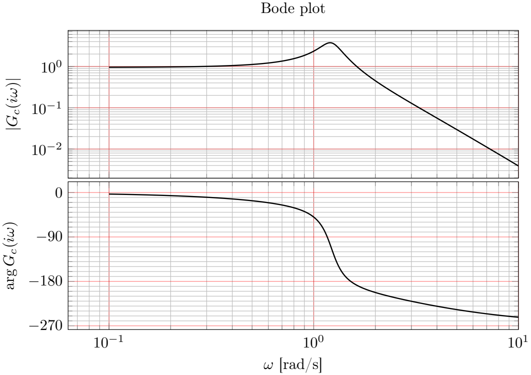


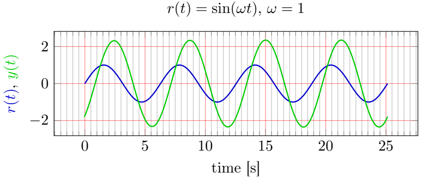
Performance requirements - frequency domain

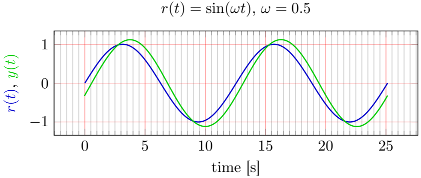


Performance requirements - frequency domain

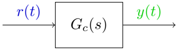


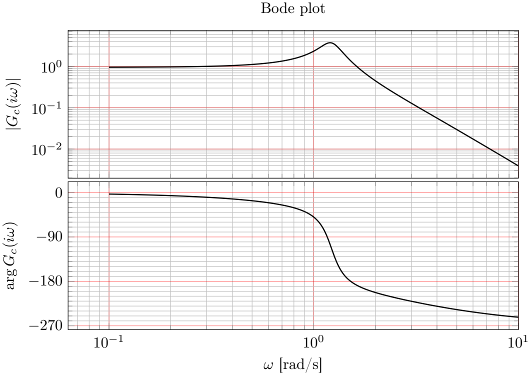


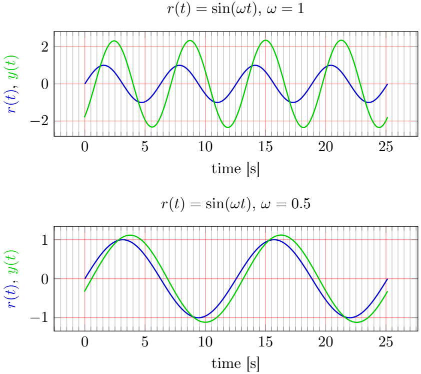




Performance requirements - frequency domain

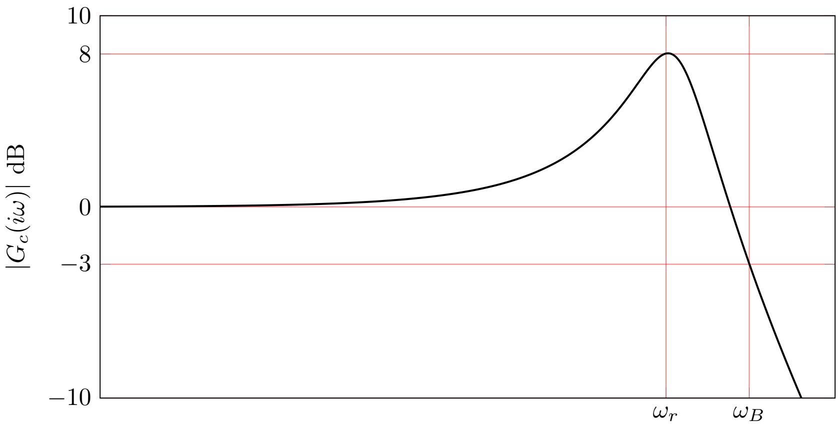






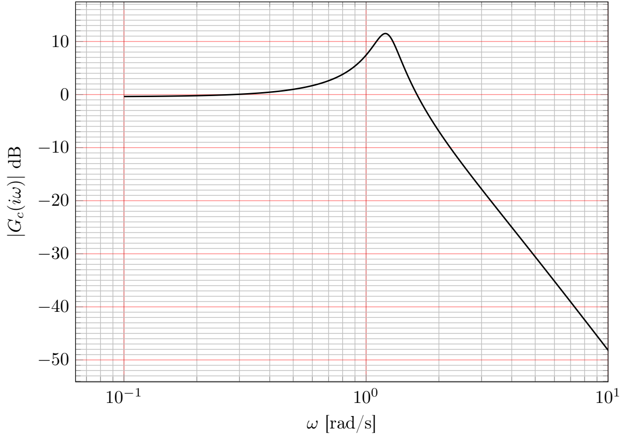
Activity What is the gain and phase shift at $\omega = 2$ rad/s?

Performance requirements - frequency domain



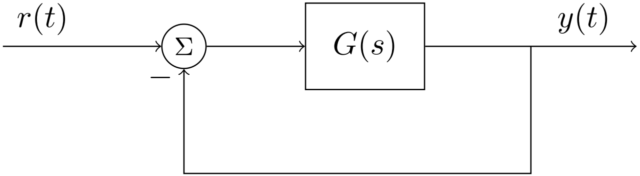
Performance requirements - frequency domain

Activity Does the system satisfy the requirements?



Bandwidth	>3 rad/s
Resonance peak	<9dB

Block diagram algebra



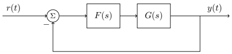
Transfer function from $r(t)$ to $y(t)$:

$$\frac{Y(s)}{R(s)} = \frac{G(s)}{1 + G(s)}$$

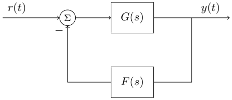
Block diagram algebra

Activity Pair the block-diagram with the correct closed-loop transfer function!

A



B



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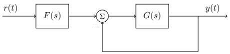
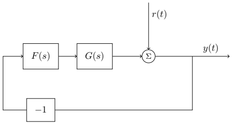


D



I

$$\frac{Y(s)}{R(s)} = \frac{G(s)F(s)}{1+G(s)}$$

II

$$\frac{Y(s)}{R(s)} = \frac{G(s)}{1+G(s)F(s)}$$

III

$$\frac{Y(s)}{R(s)} = \frac{1}{1+G(s)F(s)}$$

IV

$$\frac{Y(s)}{R(s)} = \frac{G(s)F(s)}{1+G(s)F(s)}$$