Computation exercise 2(a): Actuator design

Mechatronic systems
376.050
2014W

Important: Answers must be a hard copy and submitted to the office in CA0421 by December 17, 2014 at 4pm. The work must be original.

Fig. 1 shows a lumped mass model of a positioning system using a Lorentz actuator. The power is provided by a current amplifier. The disturbance to be corrected has a power spectral density of 1 μm/$\sqrt{\text{Hz}}$ and a bandwidth of 100 Hz. The assignment is to compute amplifier requirements in terms of voltage and current.

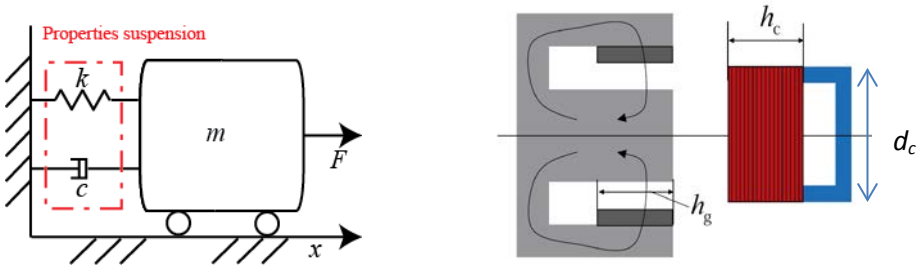

Fig. 1: A lumped mass model of a positioning system, and a schematic of a Lorentz actuator

Parameter	Value	Unit	
m	0.5	kg	Mover mass
k	$30 \cdot 10^3$	N/m	Stiffness
c	1	N/(m/s)	Damping
n	100	~	Number of windings
d_c	10	mm	Diameter coil
d_w	0.5	mm	Diameter wire
h_c	5	mm	Height coil
B	1	T	Magnetic field strength
ρ	$1.7 \cdot 10^{-8}$	Ω/m	Specific resistance
μ_0	$4\pi \cdot 10^{-7}$	NA^2	Permitivity in vacuum
μ_r	100	~	Relative permitivity

i. Determine the Resistance, self-inductance of the coil and the motor constant of the actuator. [20%]

ii. Determine the transfer function from input-current to displacement x/I and the input-current to voltage [30%]

iii. Determine the required current and the voltage [30%]