

Fakulta strojní VŠB – TUO

Department of Control Systems and Instrumentation

Automatic Control Devices
2023
(Materials for write notes)

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Lecture No. 3
Actuators and their drives

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What do you find out?

- Actuators
- Drives, structure, management
 - DC motors
 - AC motors
 - Piezomotors
 - Coils, magnets
-

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- Action member is ...

Control System

Reference Input

Error Signal

Control Algorithm

Actuator

Plant

Output

Feedback Signal

Sensor

Drive is included

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Media flow

- Valve - is


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Media flow

- Slide Valves, is

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Temperature



- Heating coil –
- ...
- It usually includes

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Air flow



- The active element

Use:

- ...

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Rotational movement



- The action ...

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Linear motion



- For actuators implementing rectilinear movement,

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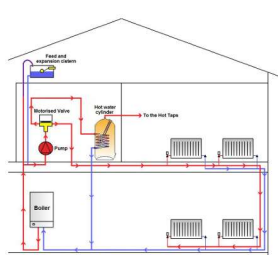
The angle of rotation



- Flap

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Use of drives for actuators in regulation



- An electric drive
- A heating coil
- Valves that
-

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Drives

- Drives can be divided according to the form of energy consumed as follows

- Mechanical drives can perform two types of motion

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Actuators (example depends on technology)

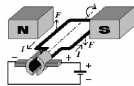
- Regulators for controlling the flow of gases, air and liquids
 - ...
- Temperature regulation
 - ...
- Speed control
 - ...
- Position regulation
 - ...



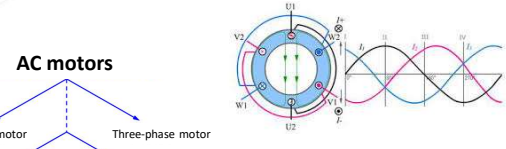
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Drives

- Electric drives



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Drives



AC motors

- Single-phase motor
 - synchronous motor
 - asynchronous motor
- Three-phase motor
 - synchronous motor =
 - asynchronous motor =

The diagram shows a cross-section of a motor with stator windings labeled U1, U2, V1, V2, W1, W2 and rotor windings labeled U, V, W. It also shows three-phase sinusoidal waveforms.


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Asynchronous motors

The three-phase asynchronous motor is


A three-phase

The coils are usually located in the stator.

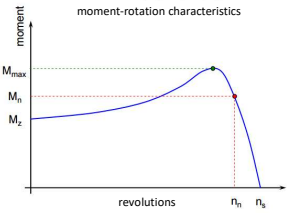


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Asynchronous motors



moment-rotation characteristics



The phases (coils) of an asynchronous motor can be ...

The graph plots moment on the y-axis and revolutions on the x-axis. Key points are labeled: M_{max} (maximum moment), M_n (nominal moment), M_2 (starting moment), n_{n1} (nominal speed), and n_s (synchronous speed).

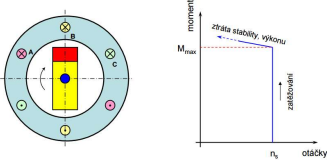
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Asynchronous motors

We can control asynchronous motors:



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Synchronous motors

Three-phase synchronous motors are



The diagram shows a cross-section of a synchronous motor rotor with a central shaft and two main poles. To the right is a graph of torque (otáčky) versus moment (moment). The graph shows a constant torque region labeled 'zátěžová oblast' (load region) and a region of stable equilibrium labeled 'oblast stability vyhovu' (region of stable equilibrium). The maximum moment is labeled M_{max} and the synchronous speed is labeled n_s .

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Single-phase commutator motors

The speed of an asynchronous motor is

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 DC motors

According to the excitation, we distinguish:

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 DC motors

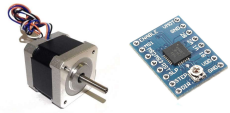
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 Commutator

Commutator

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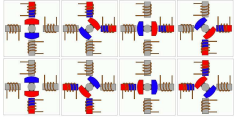
Stepper motors

A **stepper motor** is a synchronous machine, usually



Advantages

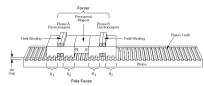
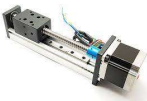
A disadvantage



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Stepper motors

- Passive Stepper Motors –
- Active stepper motors –
- Hybrid stepper motors –
- Linear stepper motors –

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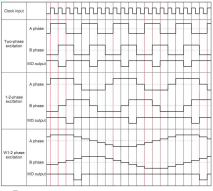
Stepper motors



A full step

Half-step

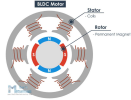
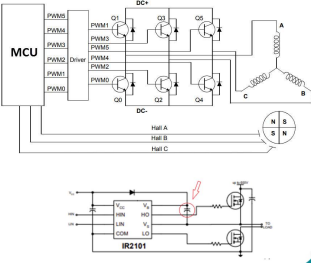

Micro Stepping



Step	L1	L2	L3	L4
1	1	0	0	0
2	1	1	0	0
3	1	0	1	0
4	1	0	0	1
5	0	1	0	0
6	0	1	1	0
7	0	1	0	1
8	0	0	1	1
9	0	0	1	0
10	0	0	0	1
11	0	1	0	0
12	0	1	1	0
13	0	1	0	1
14	0	0	1	1
15	0	0	1	0
16	0	0	0	1
17	1	0	0	0
18	1	1	0	0
19	1	0	1	0
20	1	0	0	1
21	0	1	0	0
22	0	1	1	0
23	0	1	0	1
24	0	0	1	1
25	0	0	1	0

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BLDC motor

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Servo drive

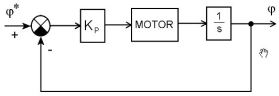
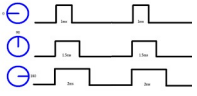

- Servo
- A servo motor,



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Servo drive

A servo motor.

The servo can be in motion:
 Loosely
 ...
 Restricted to a closed interval
 ...

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Linear motors

Rotary Motor: Stator, Windings, Rotor

Linear Motor: Stator, Windings, Air Gap, Permanent Magnet

What is Linear Induction Motor?

Electrical 4 U

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Piezoactuators

Piezoelectric phenomenon is

PI

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Connection of components

Upper part

Middle part

Bottom part (base)

Piezomotor LT2020A-090D100

Piezomotor LT2020A-101.01A00

power supply 48 V

LAN RS485

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Electromagnets

An electromagnet

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What was the content of the lecture

- Actuators
- Drives, structure, management
 - DC motors
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-

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Thank you for your attention ...

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