

Fakulta strojní VŠB – TUO
Department of Control Systems and Instrumentation

**Automatic Control Devices
2023**


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Lecture No. 1
Overview of the principles of sensors and sensors, methods of evaluation, static, dynamic properties (follow-up to the subjects Automation technology, Measurement and sensor technology). (Question 2, 3, 4, 5, 6, 7).




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What do you find out?

- An overview of the principles of sensors and sensors
 - Position
 - Distance
 - Temperature
 - Vibration
 - Force
 -
- Ways of evaluation
- Static properties
- Dynamic properties
-




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Prerequisite knowledge

- In the subjects Automation technology in the bachelor's study -



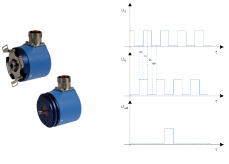
- In the subject Measurement and sensor technology in the master's study -

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Criterion I

- for measuring electrical quantities,
- ...



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Criterion I

This is one of the basic criteria used by the designer when designing measuring and control systems.

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Criterion II

- Capacitive
- ...

Typ senzoru	Princip	Charakteristika	Typická aplikace
Induktivní	Indukční	Velká spolehlivost, odolnost proti špinění a korozi	Průmysl, strojírenství
Kapacitní	Kapacitní	Malá velikost, vysoká přesnost, citlivost na změny dielektrické konstanty	Automobilový průmysl, zemědělství
Ultrazvukový	Ultrazvukový	Nezávislost na barvě, průhlednosti, povrchu	Automobilový průmysl, zdravotnictví
Teplotní	Teplotní	Vysoká přesnost, široký rozsah měření	Průmysl, výzkum
Optický	Optický	Vysoká rychlost, citlivost na změny světlosti	Automobilový průmysl, zdravotnictví

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Criterion II

Not all methods of evaluation may be suitable for measuring in the conditions of technology.

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Criterion III

- Active
- ...

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Criterion III

The essence of this criterion is whether the given sensor **needs an external source for its operation or uses energy from the technology (from the measured quantity) for its operation.**

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Criterion IV

- Continuous
- ...

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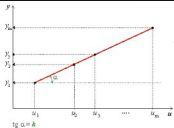
Criterion IV

Values from sensors can be **continuous** when the output (measured) **quantity is continuous in level**

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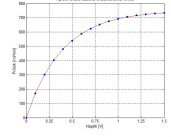
Static properties

- Static characteristic
- Class of accuracy
- Sensitivity
- Scale range of the measuring instrument
- Measuring range
- ...



$$\sigma_{\text{rel}} = \frac{|\Delta|}{X_R} 100\%$$

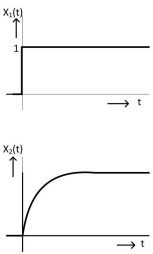
Δ_m
 X_R



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Dynamic properties

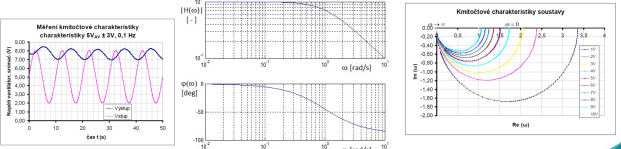
- Step respons



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Dynamic properties

- Frequency characteristic



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Requirements

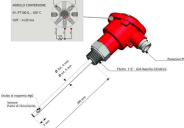
- Principle of sensor
 - measurement of dimensions, length, presence of objects, position, level height of liquids and loose materials
 - measurement of flows and pressures of gases, liquids and bulk materials
 - temperature and heat measure
 - measuring speed, shaft speed, weight, forces, torques and vibrations
 - ...

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Example sensor question

- Principle



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What methods do you know of evaluating measured quantities?
How do we connect the V-meter to the circuit, what is its internal resistance?
How do we connect an A-meter to a circuit, what is its internal resistance?

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Example sensor question

- Principle of ...
- Evaluation of

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Example sensor question

- Principle of ...
- Evaluation of

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Example sensor question

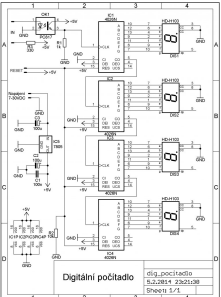
- Principle of ...
- Evaluation of

Decimal number	Q3	Q2	Q1	Q0
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

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Example sensor question

- Decadal counter for 4 orders



Number	0	1	2	3	4	5	6	7	8	9
0	1	1	1	0	0	0	0	0	0	0
1	0	1	1	0	0	0	0	0	0	0
2	0	0	1	1	0	0	0	0	0	0
3	0	0	0	1	1	0	0	0	0	0
4	0	0	0	0	1	1	0	0	0	0
5	0	0	0	0	0	1	1	0	0	0
6	0	0	0	0	0	0	1	1	0	0
7	0	0	0	0	0	0	0	1	1	0
8	0	0	0	0	0	0	0	0	1	1
9	0	0	0	0	0	0	0	0	0	1

Digitální počítadlo

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Example sensor question

- Principle of ...
- Evaluation of ...
- Mathematical dependence

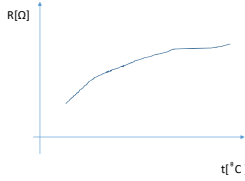
$$\Delta R = f(\Delta t)$$

$$\Delta U \approx \Delta R$$

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Example sensor question

- Principle of ...
- Evaluation of ...
- Mathematical
- Static characteristic



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Example sensor question

- Principle of ...
- Evaluation of ...
- Mathematical
- Static characteristic
- **Sampling**

Kvantovaný a vzorkovaný signál

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Example sensor question

- Principle of ...
- Evaluation of ...
- Mathematical
- Static characteristic
- Sampling
- **Practical applications**

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What was the content of the lecture

- An overview of the principles of sensors and sensors
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 - Distance
 - Temperature
 - Vibration
 - Force
 -
- Ways of evaluation
- Static properties
- Dynamic properties
-

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