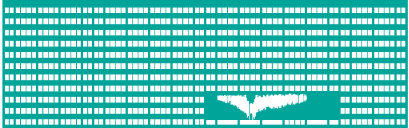




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KATEDRA
AUTOMATIZAČNÍ
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Lecture No. 2

MaSD

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What will you know?

- Interference on the measurement
- Methods for reducing errors of measuring string sensors
- Composition of the measuring chain
- Uncertainties
- Deviations
- Accuracy class
- Information links
- Ohm's Law
- Kirchhoff's laws.

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Measurement systems

Input → Sensor → Output

Physical quantity (stimulus):
.....

Signal in observable form:

Signal type:

A transducer is a device that

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Principle of sensors

Jacob Fraden: Handbook Of Modern Sensors Physics Designs And Applications
A sensor is a device that receives a stimulus and responds with an electrical signal.

Stimulus → e_1 → Transducer 1 → e_2 → Transducer 2 → e_3 → Direct sensor → Electric signal

e_1 , e_2 , e_3 , and so on are various types of energy.
The term sensor should be distinguished from transducer. The latter is a converter of one type of energy into ...

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Measurement error

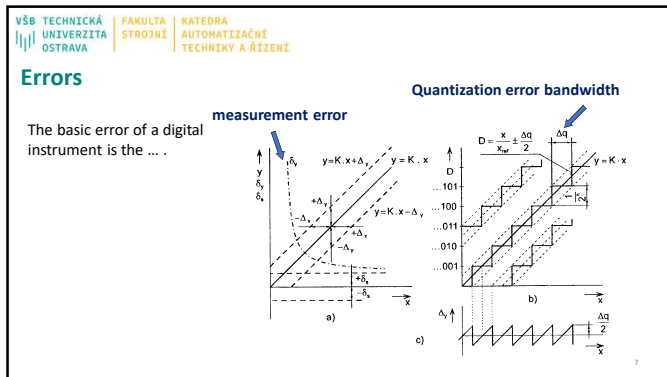
Sensitivity plot
Output signal
Input: Physical quantity
sensitivity

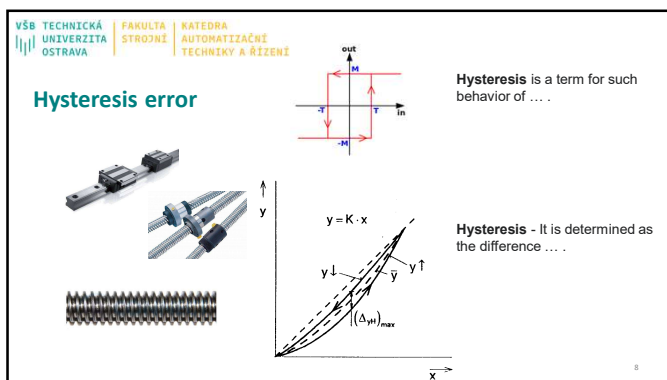
Saturation
Output signal
Linear span saturation span
Input: Physical quantity

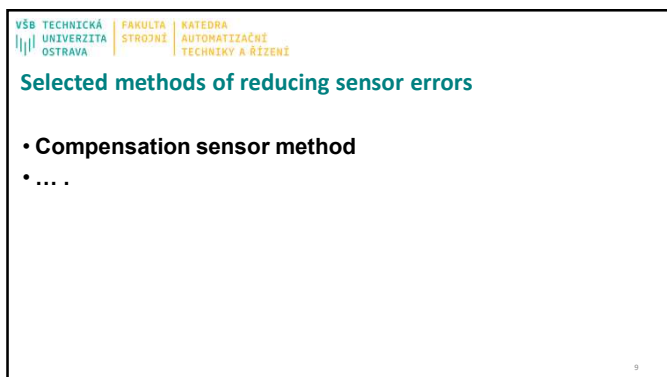
Non-linearity error
Output signal
Assumed relationship Actual relationship
Non-linearity error
Input: Physical quantity
Insertion error due to the loading
Measurement range

Hysteresis error
Output signal
hysteresis
Input: Physical quantity
Overloading

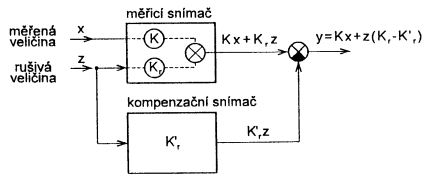
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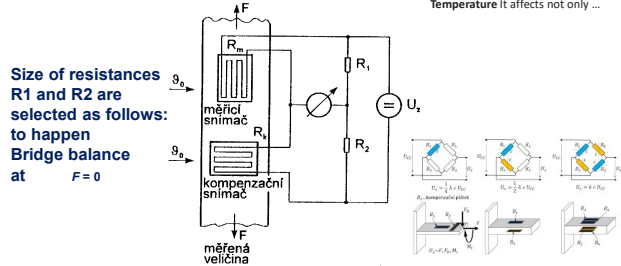


Compensation sensor method



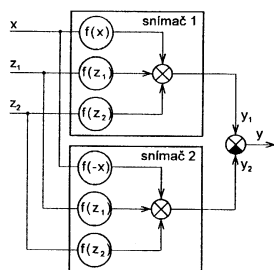
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Compensation sensor method



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Differential sensor method



The same static characteristics (mirror) are assumed.

$$y_1 = f(x, z_1, z_2)$$

$$y_2 = f(-x, z_1, z_2)$$

$$y = y_1 - y_2 = 2 K x (1 + \delta)$$

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Differential sensor method

use:

$$C = \epsilon_0 \epsilon_r \frac{S}{l}$$

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Filtration method

Application:

Filter type: • analog –

•digital –

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Filtration method

The exponential filter is given by:

$$x_F(i) = K_F \cdot x(i) + (1 - K_F) \cdot x_F(i - 1), i = 2 \dots n,$$

$$x_F(1) = x(1), 0 < K_F \leq 1.$$

K_F —
 $x(i)$ —
 $x_F(i-1)$ —

Floating averaging method

$$\bar{x} = \frac{1}{n} \sum_{i=0}^n x_{i-n}$$

n —
 i —
 x_{i-n} —

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Accuracy and errors of measurements and instruments

Absolute error is the difference between

Relative error.

$$\Delta y = y_m - y_s$$

$$\delta_y = \frac{\Delta y}{y_s} = \frac{y_m - y_s}{y_s}$$

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Accuracy and errors of measurements and instruments

- Systematic errors
-
- Random errors
-
- Measurement result

$$\bar{y} = \frac{1}{n} \sum_{i=1}^n y_i$$

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Standard deviation

- standard deviation of the sample with

- standard deviation of the arithmetic mean s_x ,

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Accuracy class

- The accuracy class



$$T_p = \frac{\Delta y_{\max}}{y_{\max} - y_{\min}} 100$$

The calculated accuracy class is rounded ...

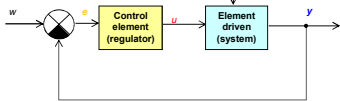


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Transfer paths in measuring technology

Control circuit diagram (serial form):



W – reference
 U – control signal
 V – feedback signal
 Y – output
 e – error signal

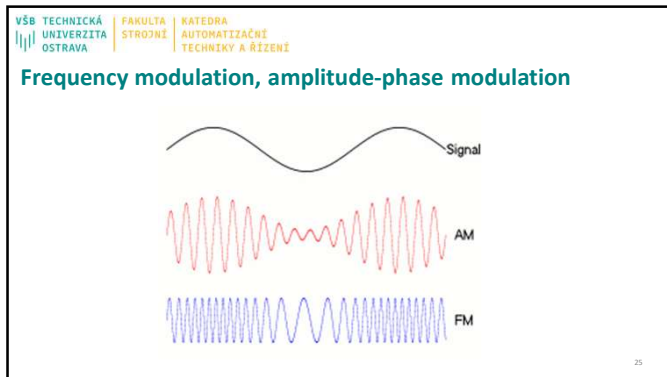
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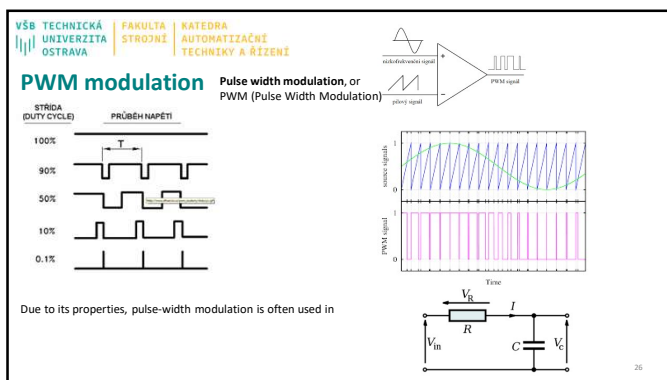
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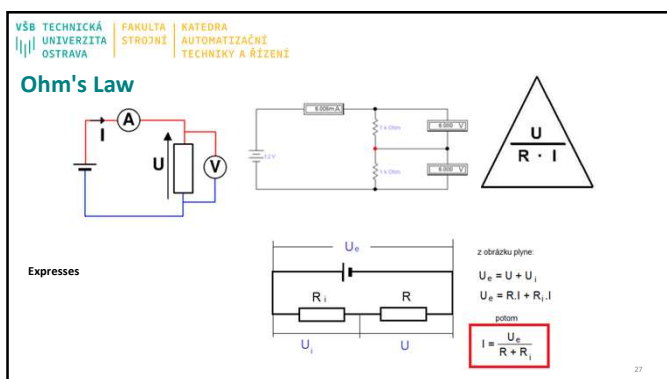
Transfer paths in measuring technology

- Analog transmission–
- Modulated transmission–
- Digital transmission- info
- Optical transmission–
- ...

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Kirchhoff's law

1. Kirchhoff's law:

$$\sum_{k=1}^n I_k = 0$$

Pro uzel A:
 $+I - I_1 - I_2 - I_3 = 0$

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Kirchhoff's law

2. Kirchhoff's law:

$$\sum_{k=1}^n U_k = \sum_{k=1}^m R_k I_k$$

Pro zvolený obvod:
 $U_e = R_3 I_3$

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Thank you for your attention
