

Fakulta strojní VŠB – TUO

Katedra automatizační techniky a řízení

Automatic Control Devices
2023
(Materials for write notes)

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Lectures

1. Familiarization with the issues and content of the studied subject. Distribution of automatic control means and their characteristics (program and technical means), control systems, hierarchical structure.
2. Overview of the principles of sensors and sensors, methods of evaluation (follow-up to the subjects Automation technology, Measurement and sensor technology).
3. Actuators and their drives.
4. Distributed control systems, teamwork solutions, its implementation and system engineer skills. SCADA/MMI systems, their properties and deployment in a hierarchical control structure (practical examples).
5. Industrial networks, basic types, 7 layer model, physical layer... application layer (protocol design, access methods, ...).
6. Wifi networks, configuration of access points and AD-HOC configuration, connection of control systems to the technological process, nomenclature (ILAN, LAN, WLAN). A sample of the laboratory set-up.

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Přednášky

7. Control systems, programmable logic automata, internal structure, development environment, PLC programming, PLC connection to the controlled system.
8. Description of higher-end single-chip computers, description of selected implemented modules.
9. Programming single-chip computers using a higher level programming language.
10. Procedures for debugging the proposed algorithms directly for the selected real task.
11. Devices supporting I2C, SPI inter-circuit communication (MEMS, memories, converters, ...). Intelligent sensors, their internal structure and description of implementation.
12. Time reserve.

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Katedra automatizační techniky a řízení

Přednáška č. 1

Familiarization with the issues and content of the studied subject. Distribution of automatic control means and their characteristics (program and technical means), control systems, hierarchical structure. (questions č. 1, 13, 14).

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Katedra automatizační techniky a řízení

What do you find out?

- Content of the studied subject
- Distribution of means of automatic control
 - Program resources
 - Technical means
- Bindings
- Management
- Control
- Regulation
- Management systems
- Management types
 - Central management
 - Distributed control systemshierarchical structure
 - Basic system concepts (system, element, connection).

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Katedra automatizační techniky a řízení

Expanding knowledge in the field of:

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Control

Control

Feedback control

Logic control

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Management methods and implementation

Logic control

Min.	Max.	Výstup (n-1)	Výstup
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	X
1	1	1	X

Max., Výstup (n-1):

Min.	00	01	11	10
0	0	1	0	0
1	1	1	X	X

Výraz 1 Výraz 2

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Management methods and implementation

PLC

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Management methods and implementation

Analog controller

Block diagram: $W \rightarrow \text{REGULÁTOR} \rightarrow \text{REGULOVANÁ SOUSTAVA} \rightarrow Y$

$$G_d(s) = \frac{U(s)}{B(s)} = \frac{K_0}{R_1} \left(1 + \frac{1}{R_1 C_1 s} + R_2 C_2 s \right) = k_p \left(1 + \frac{1}{T_i s} + T_d s \right)$$

$$k_p = \frac{R_2}{R_1}, T_i = R_1 C_1, T_d = R_2 C_2$$

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Management methods and implementation

uP

$$w(k) = k_p \left[e(k) + \frac{1}{T_i} \sum_{j=0}^k e(j) + T_d \frac{e(k) - e(k-1)}{T} \right]$$

$$w(k+1) - w(k) = k_p \left[e(k+1) - e(k) + \frac{1}{T_i} (e(k+1) - e(k)) + \frac{1}{T} (e(k) - e(k-1)) - 2e(k) + e(k-1) \right]$$

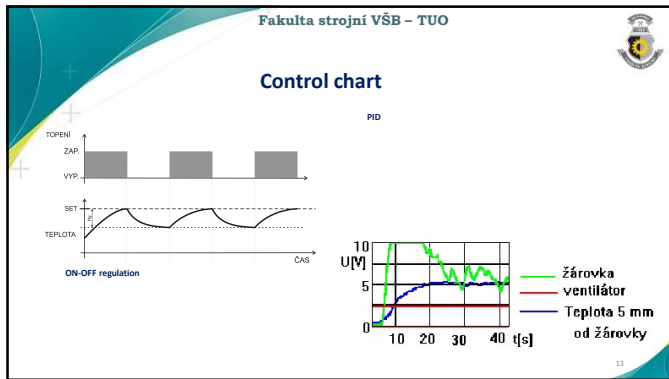
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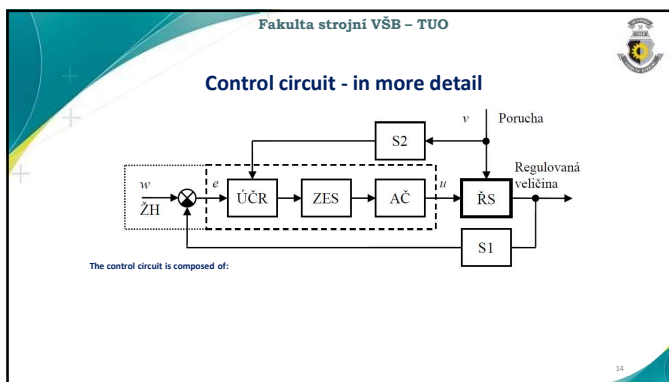
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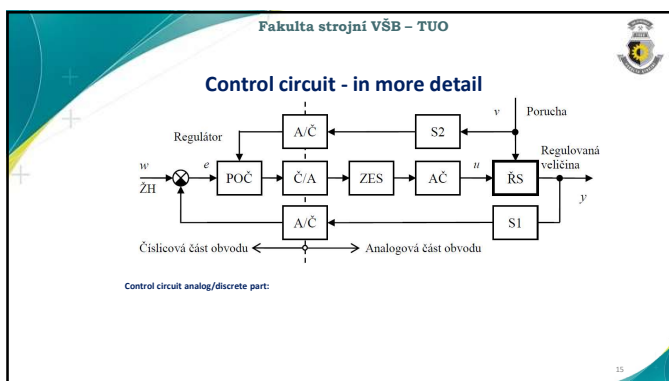
Distribution of means of automatic control and their characteristics

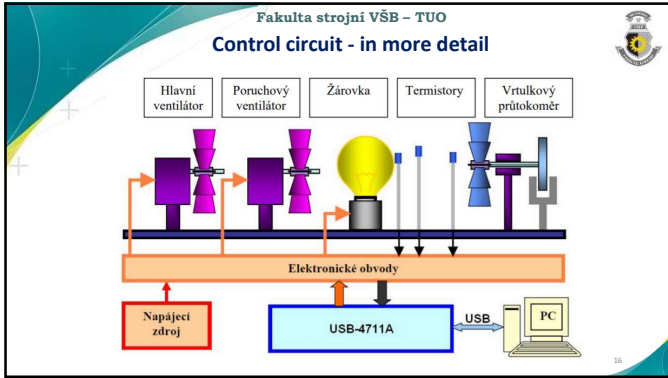
Control circuit:

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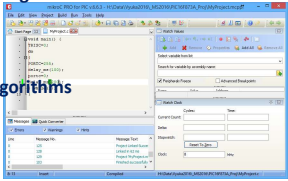
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- ### Means of automatic control - part of the control circuit
- Sensors
 - Regulators
 - Actuators
 - Regulated system.
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- ### Division of application areas - control applications
- Thermal technology
 - Chemistry
 - Material flow regulation
 - Position control and speed control
 - Application in means of transport
 - ...
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Types of programs

- Software implementing its own algorithm
- Program support for creating algorithms
- Program support for analysis and evaluation



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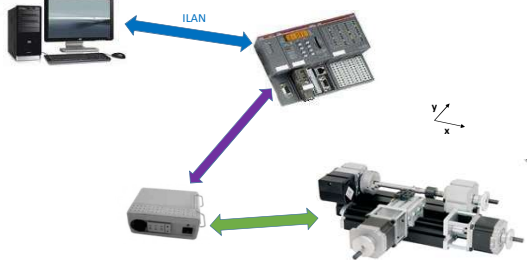
Requirements for control systems

- Increasing
- Improving
- Ability to quickly deploy the designed system
- Reducing production costs
- Easier design of control systems
- Quick search for possible control system errors
- Implementation of intelligent components
- Energy saving
- ...
- Industry 4.0

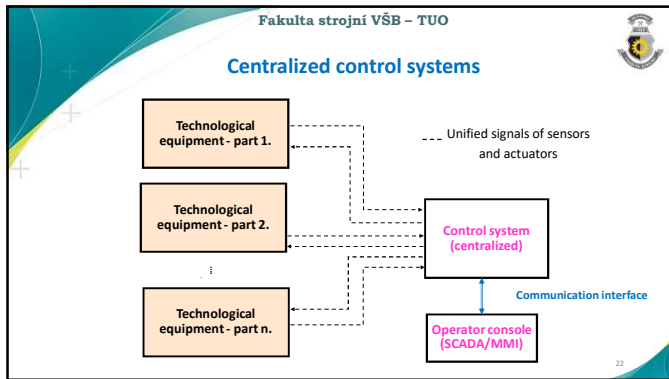
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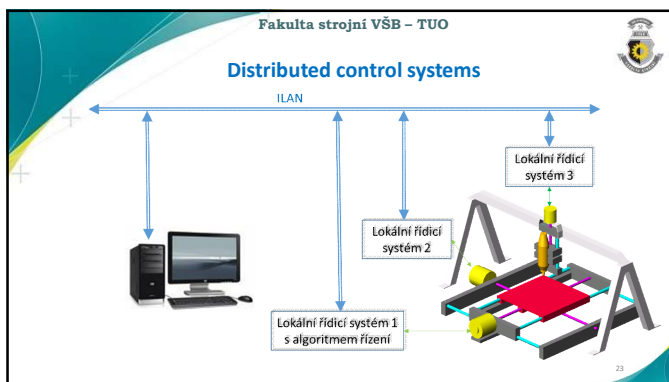
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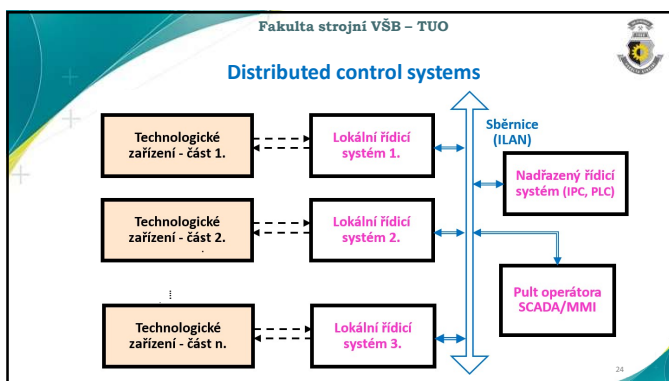
Centralized control systems

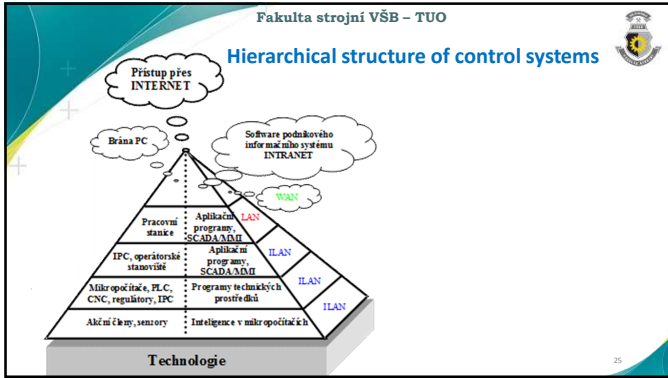


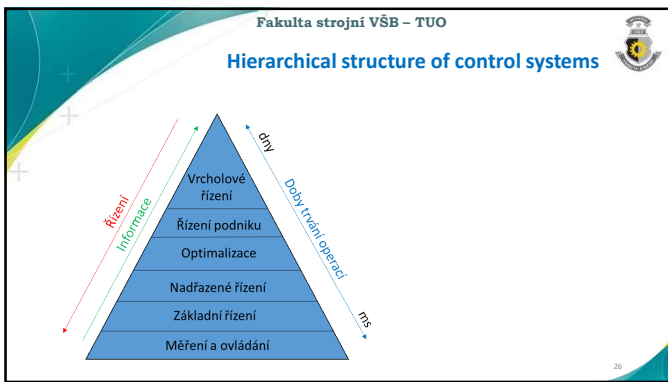
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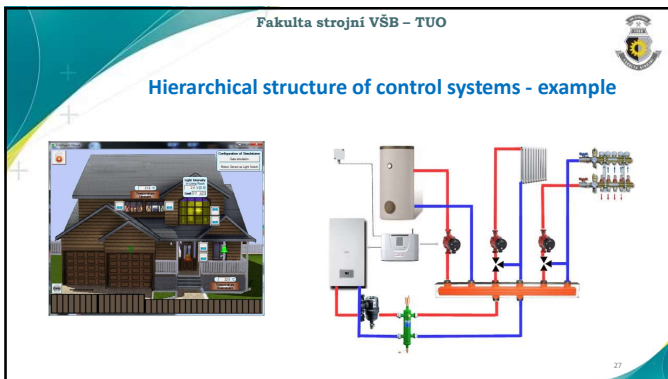












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Synthesis of control circuits

$$u(k) = k_p \left\{ e(k) + \frac{T}{T_i} \sum_{i=0}^k e(i) + T_D \frac{e(k) - e(k-1)}{T} \right\}$$

$$u(k+1) = u(k) + k_p \left[e(k+1) - e(k) + \frac{T}{T_i} e(k+1) + \frac{T_D}{T} (e(k+1) - 2e(k) + e(k-1))) \right]$$

$$CO(k) = CO(k-1) + k_p (PV(k) - PV(k-1)) + k_i T e(k) - \frac{k_D}{T} (PV(k) - 2PV(k-1) + PV(k-2))$$

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Design of distributed control systems

- Specification of the assignment of the solved task
- Distribution of control algorithms

- Selection of technical means

- Selection of information links

- Creating applications for individual levels

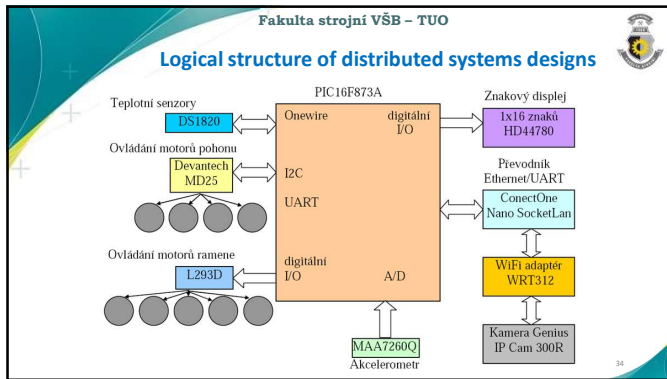
- Gradual revival and test operation of the proposed system

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Physical layout of distributed systems designs

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Thank you for your attention...

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