VSB TECHNICAL UNIVERSITY OF OSTRAVA | FACULTY OF MECHANICAL ENGINEERING | DEPARTMENT OF CONTROL SYSTEMS AND INSTRUMENTATION

Control of Mechatronic Systems

Study programme: N0714A270004 Mechatronics
Academic year: 2024/2025

1. Laplace transform (definition formulas, properties, determination of transforms and originals, solution of linear differential equations, etc.).
2. Mathematical models of linear continuous systems and their properties (differential equations, transfer functions, frequency response, step and impulse response, block diagram algebra, etc.).
3. Classification of linear dynamic systems (proportional, integrating and derivative systems, etc.).
4. Simple identification methods (on basis of step response, modification of transfer functions, etc.).
5. Linear continuous (analog) and discrete (digital) controllers (types and their properties, adjustable parameters, forms and modifications, etc.).
6. Stability of linear continuous control systems (basic transfer functions of closed-loop control system, characteristic equation and polynomial, stability definitions and conditions, stability criteria, etc.).
7. Performance of continuous control processes (performance criteria in time and frequency domain, in the complex variable plane, steady-state control errors, etc.).
8. Synthesis of continuous (analog) and discrete (digital) control systems (experimental methods; choice of sampling period in discrete control systems).
9. Synthesis of continuous (analog) and discrete (digital) control systems (analytical methods; choice of sampling period in discrete control systems).
10. Stability, controllability, and observability of linear continuous dynamic systems (interpretation, eigenvalues of system matrix, controllability and observability matrices, stabilizability and detectability, etc.).
11. Basic canonical forms of linear continuous state-space models, state-space control and Luenberger observer for linear continuous dynamic systems (ensuring of the desired control transfer function, realizability, etc.).
12. Fuzzy control (fuzzy sets and fuzzy logic, implications, fuzzification and defuzzification, basic linguistic and fuzzy control algorithms, properties and field of application of fuzzy control).
13. Modelling and simulation of dynamic systems – modelling of the systems described using linear and nonlinear differential equations. Steady-state analysis.
14. Simulation of the dynamic systems – one step and multi-step methods for solving of differential equations – algorithms, estimation error – control of the solution accuracy. Errors occurring by the numerical solution. Stability of the numerical methods for solving differential equations.
15. Modelling of the static characteristics – numerical methods used for modelling of the functions – curve fitting (approximation – linear regression, polynomial interpolation, least square method, interpolation using cubic spline function).
16. Simulation programmes – types of simulation programmes, their properties, analysis of the dynamic properties of the dynamic systems.
17. Mathematical-physical modelling, mathematical similarity, physical similarity, physical analogy. Application by the modelling and simulation of dynamic systems.

18. Control systems basic terms – closed-loop control, description of the closed-loop control system, system, element, subsystem, links, the input signal, the output signal, the hierarchical structure of the control system.

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