



MODELING AND SIMULATION II

TRACK: Cybernetics and control technology
ACADEMIC YEAR: 2024/2025, Winter Semester
LECTURER: M.Sc. Daniel Georgiev, Ph.D.
UN 528/UN 405/UN456
georgiev@kky.zcu.cz
WWW: ccy.zcu.cz/index.php/Courses

PURPOSE Design and analysis of a wide spectrum of systems is enabled through the process of modeling and simulation. This course is focused on rigorous application of tools from discrete event system analysis and stochastic simulation and analysis towards modeling and validation of complex, hybrid systems. These are demonstrated through the modeling of a electrical transmission grid.

OUTLINE The course includes 13 lectures with associated exercise sessions.

LECTURE PLAN

LEC01 20.9 - syllabus, case study, DES modeling.
LEC02 27.9 - UMDDES library, model composition, properties.
LEC03 4.10 - allowable languages, rule based design, supervisors
LEC04 11.10 - intro to discrete Markov chains.
LEC05 18.10 - analysis of discrete Markov chains.
LEC06 25.10 - simulation of Markov chains.
LEC07 1.11 - Monte Carlo method
LEC08 8.11 - Markov Chain Monte Carlo.
LEC09 15.11 - hypothesis testing.
LEC10 22.11 - Wasserstein pseudo-metric, final project.
LEC11 29.11 - review.
LEC12 6.12 - reserved time for project consultation.

REQUIREMENTS The course is graded on a curve. The final grade includes intermediate homework assignments and a final exam.

60% 3 Exercises - DES 1, DES 2, Markov Chains
40% Final exam - take home exam including coding a analysis

RECOMMENED LITERATURE Provided literature is made up of course notes, annotated source code, and technical articles. Note that not all material discussed in lecture is included in the lecture notes. Hence, the responsibility is up to you to attain the taught materials. The following are the references.

J. A. Sokolowski and C. M. Banks (editors); Modeling and simulation fundamentals: Theoretical Underpinnings and Practical Domains; John Wiley & Sons, 2010. (Sokolowski '10)

L. G. Perez, A. J. Flechsig, and V. Venkatasubramanian; Modeling the Protective System for Power System Dynamic Analysis; IEEE Trans. on Power Systems, 9(4), 1994. (Perez '94)

C. G. Cassandras and S. Lafortune; Introduction to Discrete Event Systems; Kluwer Academic Publishers, 1999. (Lafortune '99)

I. A. Hiskens and M. A. Pai; Trajectory Sensitivity Analysis of Hybrid Systems; IEEE Trans. on Circuits and Systems - Part I, 47(2), 2000. (Hiskens '00)

I. A. Hiskens and P. J. Sokolowski; Systematic Modeling and Symbolic Assisted Simulation of Power Systems, 16(2), 2001. (Hiskens '01)

J. Lygeros; Lecture notes on hybrid systems; Department of Electrical and Computer Engineering; University of Patras, 2004.