



MODELING AND SIMULATION II

TRACK: Cybernetics and control technology
ACADEMIC YEAR: 2017/2018, Winter Semester
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PURPOSE Design and analysis of a wide spectrum of systems is enabled through the process of modeling and simulation. This course is focused on the application of this process, which comprises methods of mathematical analysis, stochastic simulation, validation, ... etc. Coursework is founded on smart grid case studies.

OUTLINE The course includes 13 lectures with associated exercise sessions.

LECTURE PLAN

LEC01 Intro to M&S and smart grids [Sokolowski '10, guest lecture].
LEC02 Modeling of discrete event systems [Lafortune '99].
LEC03 Automatic composition and formal model checking [Lafortune '99].
LEC04 Discrete Markov chains [Lafortune '99].
LEC05 Modeling of implicit continuous systems [Hiskens '00].
LEC06 Characterization of hybrid models [Lygeros '04].
LEC07 Numerical methods for implicit dynamical models.
LEC08 Monte Carlo simulation [Sokolowski '10].
LEC09 Gillespie algorithm and Metropolis-Hastings Monte Carlo.
LEC10 Statistical hypothesis testing.
LEC11 Cross validation and Wasserstein pseudo-metric.
LEC12 Review.
TBD Presentations of final project

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

30% Assignment 1 - M&S of discrete event systems
30% Assignment 2 - M&S of hybrid systems
40% Final exam focused on methods of statistical validation.

RECOMMENDED 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.