

IHE 7712 – Advanced Model-Bases Approaches for Systems Analysis

Course Description

Introduction into the use of advanced model-based computer simulations for analysis of various industrial engineering-related analyses. Topics include three basic types of simulation: Systems Dynamics, Discrete Event, and Agent-Based, with the emphasis on the last. The course will outline the basic steps of a simulation-based analysis, beginning with the formulation of an appropriate problem statement, developing use cases/scenario vignettes, adapting a simulation to instantiate those cases, defining and implementing a simulation experimental design. The course will be heavily hands-on; students will learn by performing their own simulation-based analysis project.

Offered both face-to-face and online
Graduate level – 3 credit hours

Course Learning Objectives

Students enrolled in this course will learn to:

- Understand and implement the three basic simulation methodologies
- Understand and implement multi-modal methodologies
- Understand and apply the principles and procedures of simulation-based analysis
- Identify and formulate a problem for simulation-based analysis
- Identify and formulate appropriate use cases/scenario vignettes
- Identify and document critical assumptions, constraints, factors, and factor interactions
- Develop an appropriate mathematical model
- Implement that model by adapting/developing an appropriate simulation using the software platform and example models provided
- Develop and execute an appropriate simulation design of experiments for that problem
- Analyze the results, develop appropriate conclusions and recommendations
- Clearly and concisely present the model, simulation design, and the insights obtained from the analysis

Course Learning Outcomes

Upon successful completion of this course, students can:

- Understand and implement the three basic simulation methodologies
- Understand and implement multi-modal methodologies
- Understand and apply the principles and procedures of simulation-based analysis
- Identify and formulate a problem for simulation-based analysis
- Identify and formulate appropriate use cases/scenario vignettes

- Identify and document critical assumptions, constraints, factors, and factor interactions
- Develop an appropriate mathematical model
- Implement that model by adapting/developing an appropriate simulation using the software platform and example models provided
- Develop and execute an appropriate simulation design of experiments for that problem
- Analyze the results, develop appropriate conclusions and recommendations
- Clearly and concisely present the model, simulation design, and the insights obtained from the analysis

Tentative Weekly Schedule

Week 1	Introduction to Simulation-Based Analysis Introduction to Anylogic
Week 2	Sim Modeling Methods Sim Modeling Methods
Week 3	Systems Models and Simulation Modeling Discrete Event Simulation
Week 4	Modeling Complex Systems Discrete Event Modeling and the Enterprise Library
Week 5	Systems Dynamics Modeling Stocks and Flows, Eqn.s Systems Dynamics Modeling Example Models
Week 6	Agent Based Modeling Agent Basics Agent Based Modeling Networks & Communications
Week 7	Agent-Based Modeling Example Project Exam 1
Week 8	Introduction to State Charts State Chart Elements Introduction to State Charts Transitions
Week 9	Events Java: Classes, Variables, Functions
Week 10	Java: Expressions, Statements, Collections Any logic Presentation and Animation
Week 11	Project Reviews Design of Simulation Experiments
Week 12	Randomness in AnyLogic Any logic Data Input/Output
Week 13	Exam 2 Verification and Validation
Week 14	Project Reviews Project Reviews
Week 15	Final Exam