

Course Program SEN9110 - Simulation Masterclass 2024-2025

Schedule

| Monday 08:45-10:30 and Friday 08:45-10:30 | | Location |
|---|--|-------------|
| Mo 02-09 | 1. Intro, Simulation Review | ECHO Room C |
| Fr 06-09 | 2. System Theory | ECHO Room C |
| Mo 09-09 | 3. System Specification | TBM C |
| Fr 13-09 | 4. DEVS introduction | TBM C |
| Mo 16-09 | 5. DEVS and related formalisms | TBM C |
| Fr 20-09 | 6. Object-oriented simulation | TBM C |
| Mo 23-09 | 7. Parallel and Distributed simulation | TBM C |
| Fr 27-09 | 8. Distributed simulation with HLA | TBM C |
| Mo 30-09 | 9. Interactive & Real-Time Simulation | TBM C |
| Fr 04-10 | 10. Simulation and Gaming | TBM C |
| Mo 07-10 | 11. Multi-paradigm simulation | TBM C |
| Fr 11-10 | 12. Multi-resolution simulation | TBM C |
| Mo 14-10 | 13. Discrete Simulation Languages I | TBM C |
| Fr 18-10 | 14. Discrete Simulation Languages II | CEG 0.96 |
| Mo 21-10 | 15. Student paper presentations I | TBM C |
| Fr 25-10 | 16. Student paper presentations II | TBM C |

Exam:

Written exam about the full theory of the course, open book, which counts for 50% of the final mark. Materials (papers, reader, slides) will be provided digitally; you can bring any notes on paper or on a USB stick.

Exam date: Friday 8 November 2024, 09:00-12:00, CEG Computer Rooms 0.070, 4.98, 4.99

Retake date: Friday 24 January 2025, 09:00-12:00, CEG Computer Room 4.98

Term Papers

Students will work in groups of three to four to prepare a review paper about a special topic, based on reading material provided by the instructors. The written paper will count for 30% of the final grade. The term papers must be submitted as a Brightspace Assignment before 17:00 on Friday October 18, 2024. An oral presentation on the same topic will be given by the groups on 21 October and 25 October (week 8). The presentation quality will be weighed into the term paper mark. The possible themes for the term papers are the following:

- Cloud-based simulation (all)
- Crowd simulation (CoSEM or TIL, TEL, PEL)
- Cyber-physical Systems (all)
- Discrete-Event Simulation for ICT and Telecommunication (CoSEM)
- Discrete-event simulation for Policy Analysis (CoSEM, EPA)
- Discrete-Event Simulation in the Energy Sector (CoSEM)
- Financial Markets Simulation (all)
- Input analysis and input modeling for simulation (all)
- LVC (Live, Virtual, Constructive) simulation (all)
- Modeling human behavior (all)
- Output analysis for simulation (all)
- Simulation and forecasting (CoSEM, EPA)
- Simulation and optimization (all)
- Simulation and the Digital Factory (TIL, TEL, PEL)
- Simulation and virtual reality (all)
- Simulation for strategic decision making (CoSEM, EPA)
- Simulation of Logistics Systems (TIL, TEL, PEL)
- Simulation of Transportation Systems (TIL, TEL, PEL)
- Supply Chain Simulation (TIL, TEL, PEL)
- Verification, Validation and Accreditation (all)
- Web-based simulation (all)

Other topics can be proposed. In principle, there can be only one group per topic, but if we have a large group, I allow multiple groups per topic. For most topics, a couple of starting papers are already placed on the web. The groups will be coached for preparing their term paper.

Studying a Simulation Package

Students will work in the same groups of three to four to review a new simulation package, and carry out a number of small simulation studies using the package. In week 7 of the course, we will compare and contrast some of these packages, and look at the strong and weak points of different simulation tools.

The (mostly commercial) tools with a graphical user interface for model building we use for the course are:

- **Simio** (discrete-event; full license available)
- **Plant Simulation** (discrete-event; full license available)
- **Enterprise Dynamics** (discrete-event; full license available)
- **JaamSim** (discrete-event; open source, Java-based; drag-and-drop user interface)
- **AnyLogic** (discrete-event and agent-based; student license available)
- **AutoMod** (discrete-event; student license available)
- **Arena** (discrete-event; student license available)
- **ExtendSim** (discrete-event; demo license available)
- **ProModel** (discrete-event; demo license available)
- **FlexSim** (discrete-event; trial license available)
- **GPSS/H** (discrete-event; student license; but limited model building interface)

Note that the packages with demo or trial licenses might be harder to work with in terms of the assignments than the packages with a full license or a student license.

For the following packages, the models are built by programming:

- **DSOL** (discrete-event; open source, Java-based)
- **pydsol** (discrete-event; open source, Python based)
- **SimPy** (discrete-event; open source, Python based)
- **Salabim** (discrete-event; open source, Python-based)
- **NetLogo** (agent-based; open license, own language)
- **MESA** (agent-based, open source, Python-based)
- **GAMA** (agent-based, open source, Java-based)

If you want to use another package, just ask! The plan for using the simulation software is as follows:

Week 1: group formation; choosing the simulation package

Week 2: installation, learning about the package, running demo models

Week 3: implementing a small queueing model

Week 4: implementing a small model with animation

Week 5: carrying out a more extensive experiment with a model

Week 6: scoring the simulation package using a comparison sheet

Week 7: discussion of the merits of the simulation package i.r.t. others and comparing packages

Planning

In week 1, at the latest on Thursday at 17:00, (1) register your group in Brightspace, (2) send an email with your group number, top-3 for the paper topic, and top-3 for the simulation package to a.verbraeck@tudelft.nl.