

# Advanced Modelling, Gaming and Design

## ***Coordinator contact information***

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## ***Description***

This specialisation provides students with state of the art knowledge in modelling, gaming and design. Advanced modelling and gaming are ways to understand, manage and design complex systems.

As a follow on from basic courses on systems modeling and design, this specialisation:

1. deepens students' knowledge in the area of modeling and simulation  
Advanced courses in discrete event simulation and agent based modeling are part of the specialisation.
2. introduces the fields of simulation gaming and participatory systems  
Simulation gaming comprises science by design of games that have another objective than pure entertainment. Such games represent a multi-stakeholder situation, which allows the system to be studied and participants to learn from it.  
Participatory systems leverage the power of ICT to enable and facilitate engagement and empowerment. Participatory systems are large scale socio-technical systems designed with the purpose to provide a technical and social infrastructure to support participation.

## ***Job perspectives***

Modeling, gaming and design are used in many of the organisations that are current employers of our graduates. For example in management consultancies, such as Accenture; companies in the energy sector, such as Enxsis or Shell; companies in the transport sector, such as KLM, Prorail or the Rotterdam Port Authority; Ministries, such as the Ministry of Infrastructure and the Environment; institutes for applied research, such as Deltares and TNO. A number of former students who specialised in modeling, gaming and design have set up their own consultancy firms (Initi8, TBA, Vreelandgroep).

## ***Courses: choose 3 out of 4***

### **1<sup>st</sup> period**

#### **SEN9110 Simulation Masterclass (5 EC)**

System Theory, Object Orientation, Discrete Event System Specification, Multi-Formalism Simulation, and Real-Time Distributed Simulation will be the core topics of the course. After an introduction to system theory, the inner working of simulation environments will be illustrated on the basis of the DEVS, DESS, and DTSS formalisms. Then, possible integrating of the different formalisms will be shown. Several special topics will be taught, based on the latest research in simulation. This material will be illustrated in intensive and interactive courses. Several simulation topics will be studied by groups of students, who will write a scientific paper, and present their findings in class. These topics can be focused on the MSc program that the students participate in; special topics to study are available for TIL, CoSEM, EPA, Computer Science, and other students. Finally, groups of students will study a simulation package in-depth and discuss the commonalities and differences with other packages. Again, the package chosen can be targeted at the MSc program of the student group.

After taking this course the student will have knowledge about:

- internal working of different kinds of discrete event simulation languages and environments;
- underlying theories and formalisms of discrete event simulation, such as DEVS and DESS;
- important differences and similarities between simulation environments;
- drivers for successful and less successful simulation studies;
- object-oriented simulation environments;

- structure and abilities of distributed simulation; the concept of HLA;
- latest research activities in the field of simulation, with research topics like web-based and cloud-based simulation, heavily distributed simulation, simulation using real-time data, agent based simulation, interactive simulation, and simulation in special domains.

For more information, please contact Alexander Verbraeck ([A.Verbraeck@tudelft.nl](mailto:A.Verbraeck@tudelft.nl)).

### **SEN9235 Game Design Project (5 EC)**

The simulation game design project offers conceptual insights as well as 'hands on' experience with simulation-gaming (SG). SG is an established field of practice with proven value for instance in the field of spatial and urban planning, ecology, engineering and design, public administration, business management, learning, research and consultancy. The staggering growth and success of the video gaming industry has triggered the interest in simulation games – from paper based games to video games for learning and policy making - even more. Experienced speakers will give lectures on history, future, design, typology and facilitation of SG. Experts and students will discuss the role of computers and video games, but emphasis is NOT on technology! Students will have ample opportunity to try out a number of (role-playing, board etc.) games that hold powerful messages about decision-making and management. Students are challenged to develop and facilitate their own simulation game to support decision-making, learning, training, business, management and change. In a small group, they will also work on a scientific question related to game design. Besides creativity and enthusiasm, there are no entry requirements. Lectures and workshops will be arranged in a condensed fashion on 10 full days from 9.00 – 17.00. External companies and organizations provide brief problem statements and game requirements, and act as 'clients'. Students can define their own topic/client. There is a (restricted and conditional) possibility for external participants (from companies, non-profit organizations, other universities) to participate in the course.

After completion of this course the students will have acquired knowledge and insights about: The history, backgrounds, key-concepts, formats and applications of simulation games.

After completion of this course the student will be able to:

1. Design a (prototype) of a simulation game to be used for learning, research or intervention
2. Apply a game design cycle (or systematic design steps)
3. Define, conceptualize and construct the various game components
4. Facilitate simple simulation games

For more information, please contact Geertje Bekebrede ([g.bekebrede@tudelft.nl](mailto:g.bekebrede@tudelft.nl))

## **2<sup>nd</sup> period**

### **SEN9120 Advanced Agent Based Modeling (5 ECTS)**

Building on Complex Adaptive Systems theory and basic Agent Based Modeling knowledge presented in SEN1211, the Advanced course will focus on the model development process. This course a compulsory prerequisite, and can be considered as an free elective for non-SEPAM students.

The students are expected to conceptualize, develop and verify a model during the course, individually or in a group. The modeling tasks will be, as much as possible, based on real life research problems, formulated by various research groups from within and outside the faculty.

The main goal of the course is to learn how to form a modeling question, perform a system decomposition, conceptualize and formalize the system elements, implement and verify the simulation and validate an Agent Based Model of a socio-technical system. The course will consist of a series of lectures detailing the different modelling steps, and the development of a model, using this knowledge. Models will be developed in a group setting. The course will use NetLogo, for Agent Based Model development.

The materials consists of course lecture slides and the book "Agent-based modelling of socio-technical systems" Edited by K.H. Van Dam, I. Nikolic and Z. Lukszo

The grade is determined by the model quality and the report produced by the student group.

For more information, please contact Dr. ir. Igor Nikolic ([I.Nikolic@tudelft.nl](mailto:I.Nikolic@tudelft.nl)).

### **SEN9115 Participatory system (5 ECTS)**

Global connectivity and increasingly mobile ways of living have enabled people to tap into the knowledge of their peers and large networks of experts or volunteers. Because of its potential for information collection, sharing and, increasingly, creation, decision-makers often attribute extraordinary abilities to modern ICT networks, including bringing democracy where there is none, learning and education, economic growth, citizen engagement, job creation and better decision making in crises.

The objective of this course is therefore to design participatory systems, systems that enable and support participation in today's changing organisations and society. Participatory systems are ICT enabled (large scale) socio-technical systems in today's networked society, designed with a mission. Participatory systems provide a technical and social infrastructure to support participation, enabling citizens to take responsibility and providing them with the ability to act. Green Wheels, Vrienden op de Fiets, Geocaching, are examples of participatory systems.

Of specific interest are large scale participatory systems for which global management is based on local coordination such as smart energy communities, supply and demand networks, crisis management systems: systems for which self-management and emergence is characteristic.

The course focuses on the leading design principles:

- design for trust: transparency, security, integrity, privacy, resilience
- design for engagement: interaction, presence, communication, awareness, co-creation, commitment, involvement (continuous)
- design for empowerment: autonomy, self-organization, emergence, enactment

Starting from these design principles, the course will combine theoretical and methodological elements with hands-on work on selected design challenges.

After completion of the course, the student is able to:

- design participatory systems.

For more information, please contact Frances Brazier ([f.m.brazier@tudelft.nl](mailto:f.m.brazier@tudelft.nl)).

### ***Additional information***

Please be aware of specific prerequisites per individual course. For SEN9110 the prerequisites are some prior experience in Discrete Event Simulation (e.g. TB233 Discrete Simulatie, EPA1324 Introduction to TPM modelling, or ME44305 System Analysis and Simulation). For SEN9120 Advanced ABM, prerequisite is SEN1211