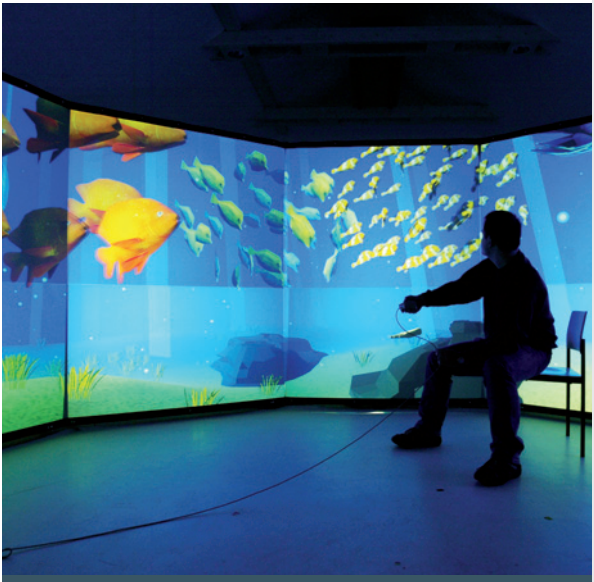
TU Clausthal

International Simulation Science Semester (ISSS)

October – March



Internationales Zentrum Clausthal (IZC)
International Center Clausthal (IZC)

Clausthal University of Technology

Clausthal University of Technology (TUC) is an internationally renowned institution with a long tradition of quality education recognized and valued by many national as well as international companies.

We are a small university with around 4,800 students from all over the world. Students can enjoy excellent study conditions in the fields of engineering, natural sciences and management.

Research and education at Clausthal University of Technology are focused on Energy and Raw Materials, Natural Science and Materials Science, Economics, Mathematics, Computer Science, Mechanical Engineering and Process Engineering.

In three innovative centers, the Energy Research Center Niedersachsen (EFZN), the Clausthal Cen-

ter of Materials Engineering (CZM) and the Center of Simulation Science (SWZ), we aim to link applied research in natural sciences, engineering and economics.

Young people enjoy a different and unique way of studying in Clausthal: it is the personal atmosphere and the practice-oriented education that make us distinctive. Beyond that, students and employees enjoy the international atmosphere at TUC, the extensive nature of the Harz Mountains and more than 60 different kinds of sports ranging from skiing to sailing and mountain biking offered by the Sports Institute.

The superb worldwide reputation of Clausthal University of Technology is regularly reflected in comparative university rankings where TUC enjoys a leading position.

Every winter term TU Clausthal (TUC) offers an International Simulation Science Semester (ISSS). It is organized jointly by the Simulation Science Center Clausthal-Göttingen (SWZ) and the International Center Clausthal (IZC). The ISSS is a great opportunity for students to gain experience and orientation in international study programs required in a globalized world.

Module 1:

Introduction into Computational Modeling and Simulation

3 ECTS Credits

Lecturer: Prof. Dr. Dietmar P. F. Moeller (TUC/UHH)

The power of simulation lies in the three R´s of science and engineering, namely: reductionism, repeatability, and refutation. That is why this course is organized as follows: The introductory part focuses on modeling and the essential mathematical methods executed in continuous-time, discrete-time and distributed systems following the fundamental laws in science and engineering. The subsequent training part focuses on the utilization of an industry standard simulation framework and the validation and verification of results of computer-based simulation. To this end, students develop, evaluate and present the simulation results in a plenary workshop at the end of the course.

Module 2:

Introduction into Stochastic Systems Modeling and Simulation

3 ECTS Credits (Block Course)

Lecturer: Prof. Dr. Thomas Hanschke (TUC),
Dr. Horst Zisgen (IBM),
Dipl.-Wirt.-Inf. Wiebke Klünder (TUC)

Stochastic systems modeling and simulation explore stochastic systems which could be defined as anything random that changes in time. Stochastic systems are at the core of a number of disciplines

in science and engineering, for example communication systems, machine learning, and more. The course will introduce students into the basics of the probability theory: probability spaces, conditional probability time and limits in probability, common probability distributions (binominal, exponential, Poisson, Gaussian), queuing systems models, Markov chains, random processes.

Module 3:

Introduction into Computational Modeling and Simulation in Mechanical Engineering

3 ECTS Credits

Lecturer: Prof. Dr. Gunther Brenner (TUC)

In the 21st century decision making increasingly relies on computer simulations. Prominent examples are weather forecasts or predictions of financial or environmental scenarios. Computational methods have become indispensable tools in the context of designing and optimization of processes and products. Therefore, students of engineering sciences have to be made familiar with the ideas of simulation and the use of modern software tools. The goal of the present course is to familiarize students with the basic concepts of computational methods and to

provide competences that allow them to utilize these tools in a targeted manner and to assess results critically. Further in-depth knowledge of physical and mathematical details may be imparted subsequently in further lectures.

Module 4:

Agent-based Modeling and Simulation

1 ECTS Credit (Block course 2 days)

Lecturer: Prof. Dr. Jörg Müller (TUC)

We are witnesses to growing complexity of today's systems for managing/controlling critical networked infrastructure systems for traffic, logistics, energy, or industry automation. These systems are systems of systems (SoS), i.e., large-scale concurrent and distributed systems that are themselves comprised of complex autonomous systems and that are characterized by operational and managerial independence, geographic distribution, emergent behavior, and evolutionary development. Decentralization and the often stochastic nature of the environment are further properties of such systems.

Modeling and simulation of systems of systems require suitable abstractions to express autonomy of systems and often loosely-coupled interaction between these systems. In this lecture, we shall introduce concepts of the multiagent-based modeling and simulation paradigm, which provides these types

of abstractions. Starting from the notion of autonomous intelligent agents and multiagent systems, we shall review models for interaction, coordination, and cooperation. Benefits but also challenges of agent-based modeling and simulation will be discussed by means of selected application scenarios. In a practical part, attendants of the lecture will have the opportunity to model small examples of multiagent systems using the AgentSpeak modeling language.

Module 5:
Transportation Analysis, Modeling and Simulation
3 ECTS Credits

Lecturer: Prof. Dr. Dietmar P. F. Moeller (TUC/UHH)

The transportation systems sector – comprising modes of transportation, each with different operational structures and approaches to security – is a vast, open, interdependent network, moving millions of tons of freight and millions of passengers. Every day, the transportation systems network connects cities, manufacturers, and retailers by moving large volumes of freight and passengers through a complex network of roads and highways, railways and train stations, sea ports and dry ports, and airports and hubs. Thus, the transportation systems sector is the most important component of any modern economy's infrastructure in the globalized world. It is also a core component of daily human life with all of its essential

interdependencies, such as demands for travel within a given area and freight transportation in metropolitan areas, which require a comprehensive framework in which to integrate all aspects of the target system. Therefore, transportation systems models enable transportation managers to run their daily businesses safely and more effectively through a smarter use of transportation networks. But the transportation systems sector in today's open, interdependent network encompassing urban and metropolitan areas requires optimization of all operating conditions. This can be successfully achieved if the interactions between transportation modes, the economy, land use, and the impact on natural resources are included in transportation systems planning strategies. But the proposed future of multimodal transportation systems cannot be measured through planning alone. Mathematical models of transportation systems and mobility management, incorporating both real-world and hypothetical scenarios, should be embedded in transportation systems analysis, including the evaluation and/or design the of traffic flows, determining the most reliable mode of operation of physical (e.g., a new road) and organizational (e.g., a new destination) objects, and the interaction between the objects and their impact on the environment. These mathematical models are fundamental to the analysis, planning, and evaluation of small-, medium-, and large-scale multimodal transportation systems. The success of model-based scenario analysis can be evaluated by the resulting forecast or prediction of the transportation system response. An ideal design or operational methodology for a transportation system can be achieved using model-based analysis in conjunction with backcasting or backtracking. Thus, modeling and simulation play a central role in planning, developing, and evaluating multimodal transportation systems, improving transportation efficiency and keeping pace with the rising demands for optimizing multimodal transportation systems.

Module 6:

Student Team Project in Computational Modeling and Simulation

6 ECTS Credits

Student team project, supervisor depends on chosen topic

Within the student team project, groups of students which work on a specific topic offered by the lecturers of the International Simulation Science Semester are formed. The student team project groups will analyze, present, discuss, and publish (conference or journal) one specific topic, such as:

- Dry port development in the maritime domain
- Turnaround optimization at airports
- Mobile autonomous robots in unstructured environments
- Urban mobility concepts for metropolitan areas
- Additional topics available upon request

Module 7:

Intercultural competence seminar

3 ECTS Credits

Various Lecturers

Interacting with people from different cultural backgrounds has become an important part of our daily lives. To benefit from cultural diversity, this course is designed to develop your intercultural competence in two areas: understanding culture and its impact on behavior in an international working environment, and developing communication strategies and skills to work successfully in international teams.

Module 8:

Language Training- German A 1.1 Beginners

6 ECTS Credits

Various Lecturers

German language course for beginners or learners with little knowledge of German. This course focuses on developing listening and reading comprehension, active use of German, as well as on acquiring learning techniques and communicative competence needed to study successfully at a German university.

Please note that German courses on all levels are available and can be exchanged for this course.

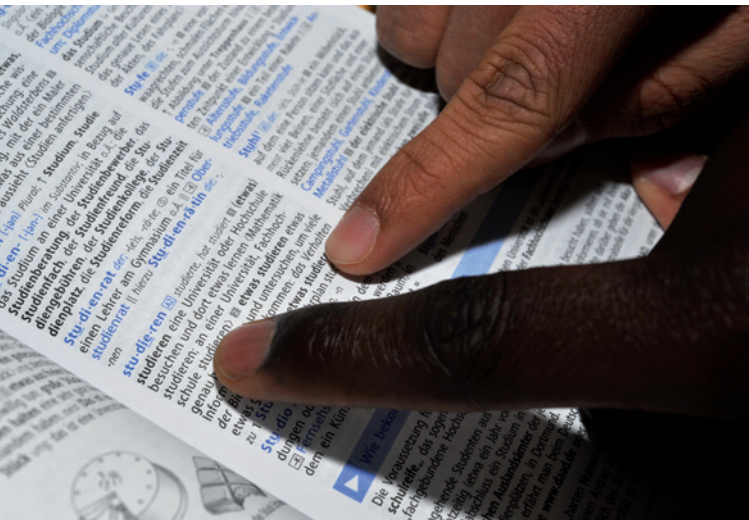
Module 9:

Language Training – European and Non-European languages

2–6 ECTS Credits

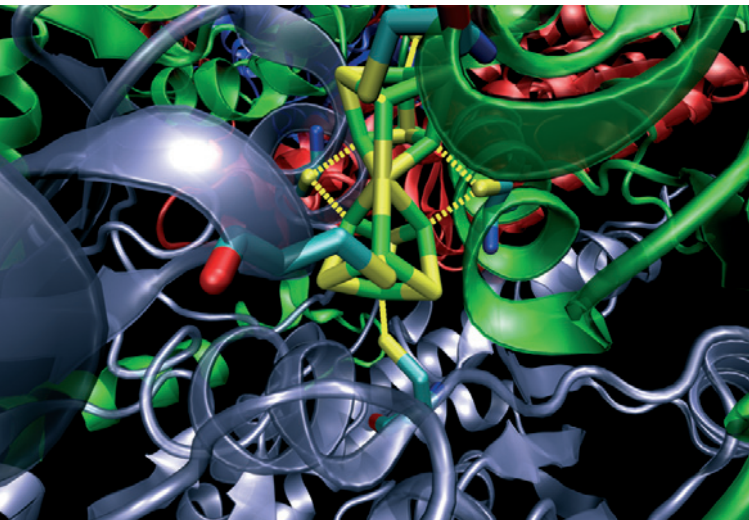
Apart from German language courses, the course range comprises: Arabic, Brazilian Portuguese, Chinese, English, French, Greek, Italian, Norwegian, Polish, Russian and Spanish. This includes courses for beginners as well as for advanced learners.

Further information can be found on the Internet.



Simulation Science Center Clausthal-Göttingen (SWZ)

The Simulation Science Center Clausthal-Göttingen (SWZ) is a joint interdisciplinary research facility of Clausthal University of Technology and of the University of Göttingen. The core research areas of the SWZ are developments in mathematical modeling and simulation techniques, as well as general simulation methodology and its real world applications, such as simulation and optimization of networks, material simulation, distributed simulation, etc. In this context the power of simulation lies in the three R's of science and engineering, namely: reductionism, repeatability, and refutation. Reductionism recognizes that any system can be decomposed into a set of components that follows fundamental laws of science and engineering. Thus, the diversity of the real world can be reduced into laboratory experiments, which can be validated by their repeatability, and one can make intellectual progress by the refutation of the hypothesis. Therefore, modeling and simulation are very important methods in science and engineering and have become a central activity in all disciplines in science and engineering which allow analyzing systems accurately under varying operation conditions and/or scenarios to predict the system behavior before the system is actually built.



International Center Clausthal (IZC)

In cooperation with the university management and the institutes, the International Center Clausthal (IZC) coordinates the international relations and activities of Clausthal University of Technology (TUC). The IZC is the central service point for international and German students as well as for university staff and faculty.

The IZC Language Center offers a wide range of language courses. For students and university staff participation in these language courses is free. Furthermore the IZC Language Center coordinates language tandems.

We are looking forward to welcoming you at Clausthal University of Technology!

Contact

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