

# Master's Program in Simulation Sciences

## Degree Awarded

Master of Science RWTH Aachen University (MSc RWTH)

## Duration

4 semesters (120 credit points)

## Start

Winter semester

## What is Simulation Sciences (SiSc)?

SiSc is an interdisciplinary Master's program taught in English for holders of a Bachelor's degree in a science or engineering subject. The course is organized by the German Research School for Simulation Sciences, a joint graduate school of RWTH Aachen University and Forschungszentrum Jülich.

Simulation sciences is taken to mean those disciplines which, on the one hand, deal with basic methodological principles and, on the other hand, with applications of computer simulations in science and engineering. Due to the exponential development of modern high-performance computers, these disciplines are gaining ever greater significance and now represent the third pillar of research complementing experiment and theory. Well-known areas in which computer simulations are extensively used are, for instance, climate research, materials science and biotechnology.

In this program, students will learn the basic principles, concepts and methods of the simulation sciences. After completing the program, graduates will be in a position to work independently on complex tasks in various fields of application in science and engineering which require high-performance computing.

## General Description of the Master's Program

The course lasting four semesters consists of mandatory and elective courses and a written Master's thesis. The entire course is conducted in English. In the mandatory courses, the students will acquire a knowledge basis enabling them to deal rapidly with problems in the field of simulation sciences. The students' individual choice of elective courses enables them to tailor the focus of their personal program – either application- or method-oriented, interdisciplinary or subject-specific.

### Mandatory courses:

Mandatory courses are courses which have to be taken by all students on the program. The following lectures, exercises and laboratory courses are mandatory:

Numerical Methods for Partial Differential Equations, From Molecular to Continuum Physics I + II, Data Analysis and Visualization, Parallel Programming I, Applied Quantum Mechanics, Fast Iterative Solvers, Parallel Computing in Simulation Sciences, Model-based Estimation Methods, Simulation Sciences Laboratory

### Elective courses:

Elective courses can be chosen from a wide range comprising the following fields:

Energy / Process / Control / Biomedical / Production / Communications Engineering, Fluid / Structural Mechanics, Materials / Computer Science, Physics, Chemistry, Geosciences, Mathematics

### Master's thesis:

The Master's thesis is a dissertation written in English giving students the opportunity to demonstrate their ability to work independently and scientifically on a problem from the field of simulation sciences within a given time frame of 26 weeks. At the end of this period, students will defend their thesis in a Master's colloquium.

All professors of the German Research School for Simulation Sciences, RWTH Aachen University and Forschungszentrum Jülich are potentially available to supervise Master's theses if a reference to simulation is given.

## What are the requirements?

Requirements for this course are an accredited first university degree, certified English skills and documented proof of qualification for simulation sciences. The German Research School for Simulation Sciences and the board of examiners for Simulation Sciences from RWTH Aachen University will decide on the special qualifications. Knowledge of the following fields will be tested (not all need to be covered): basic principles of mechanical or electrical engineering, basic mathematical and physical principles, scien-

tific knowledge of chemistry or physics, basic principles of computer science, basic principles of simulation techniques, knowledge in one or more fields of application.

Furthermore, sequential programming knowledge is required, in particular in imperative languages such as C or Fortran.

### Profile of the SiSc Course

The special feature of the interdisciplinary Simulation Sciences program is the training of scientists and engineers enabling them to handle the continuously growing applications of high-performance computers in science and engineering. Students will be given basic training in the methodological principles of computer simulation and, depending on their personal choice, will then complete an application-oriented or methodology-oriented program. In the field of applications, a selection can be made from a broad spectrum of courses which can either be combined in an interdisciplinary manner or focused on one priority. This concept permits students to extend their knowledge of the discipline of their Bachelor's degree or to change their field. For example, a Bachelor's in physics could be followed by a Master's in Simulation Sciences with a focus on engineering.

In the course of the program, students will be granted access to the extraordinary supercomputer and visualization resources of RWTH Aachen University and Forschungszentrum Jülich.

### Career Opportunities

Opportunities in numerous professional fields are open to graduates of the Master's program in Simulation Sciences. Due to its interdisciplinarity, the program addresses the areas of methodology, basic principles and applications of simulation sciences that are currently in very great demand.

Potential employers can be found in both research and industry. For example, cost cutting means that computer simulations now replace expensive experiments, which makes it attractive for industry to employ well-qualified experts in the field. Since the program is taught in English, the graduates are moreover well qualified for the international market.

### How can I apply?

Please send your application for the Master's program in Simulation Sciences to the German Research School for Simulation Sciences. Further information can be found at the website of the German Research School for Simulation Sciences at [www.grs-sim.de/academic-programs/master/](http://www.grs-sim.de/academic-programs/master/).

### Fees

There is no tuition fee, only a student services fee. This fee must be paid each semester (e.g. 194.80 Euros for winter semester 2010/11) and includes several services, e.g. a semester ticket.

### Further information and contact:

Academic Advisor  
Dr. Vera Kleber

German Research School  
for Simulation Sciences  
Schinkelstraße 2a  
52062 Aachen

Germany

+49-241-80-99740  
[info@grs-sim.de](mailto:info@grs-sim.de)  
[www.grs-sim.de](http://www.grs-sim.de)

1st Semester (Winter) 30 CP	2nd Semester (Summer) 30 CP	3rd Semester (Winter) 30 CP	4th Semester (Summer) 30 CP
Numerical Methods for Partial Differential Equations 4+2      8 CP	Fast Iterative Solvers 2+1      4 CP	SiSc Laboratory 0+3      6 CP	Master's Thesis 27 CP
From Molecular to Continuum Physics I 3+2      6 CP	From Molecular to Continuum Physics II 3+2      5 CP	Elective Courses 24 CP	
Applied Quantum Mechanics 3+3      6 CP	Model Based Estimation Methods 2+2      5 CP		
Parallel Programming I 3+2      6 CP	Parallel Computing in Simulation Sciences 3+2      6 CP		
Data Analysis and Visualization 2+1      4 CP	Elective Courses 10 CP		Master's Colloquium 3 CP