Computational Science and Engineering (CSE) is the multi-disciplinary field of computer-based modelling and simulation for studying scientific phenomena and engineering designs. Modelling and simulation helps to validate theory, and makes it possible to analyse scenarios that would otherwise be too time-consuming, expensive, or dangerous to study by experiment. Data exploration helps to turn numbers into insight - which is especially challenging in times of Big Data.

The increasing quest for higher levels of detail and realism does not only require enormous computational capacities. In addition, advanced programming skills, sophisticated models, and efficient numerical methods. Traditional programs in computer science, mathematics, or engineering, often do not offer an education that meets all of these requirements.

The international master's program “Computational Science and Engineering” (CSE) at TUM was established in 2001. It is intended for students with an undergraduate education in a discipline from science or engineering, and provides the skills for a successful professional or academic career in CSE. The program duration is four semesters (two years), where the fourth semester is dedicated to the master’s thesis. All compulsory lectures are given in English, while it is possible to attend additional lectures in German, as well.

As an interdisciplinary course, the CSE program is based on the three pillars: applied mathematics (esp. numerical analysis), computer science, and applications in science or engineering. In applied mathematics, CSE teaches skills in mathematical modelling and numerical analysis. In computer science, CSE focuses on efficient numerical algorithms, their (parallel) implementation, and the visualization of the results.

Finally, the spectrum of applications in science and engineering covers various fields of high industrial relevance. This includes computational fluid dynamics, computational structural mechanics, computational physics or electronics, computational methods in bioscience, but also fields related to computer science such as 3D visualization and imaging in medicine.

Curriculum

Course of studies

The CSE master’s program has a duration of four semesters. The first year is dedicated to basics in numerical analysis and informatics, and also provides an introduction to scientific computing, which includes a practical course. After the second semester, students are required to complete an industrial internship.

The second year’s focus is on two fields for application of numerical simulation. Various subjects are available, including computational fluid dynamics, computational structural mechanics, or computational physics, are offered, some of which are offered in cooperation with partner institutes at TU München or at partner universities.

The successful completion of the CSE master’s program requires 120 credits, 90 for all kinds of courses during the first three semesters and 30 for the master’s thesis in the last semester. After a
successful completion, students are awarded a Master of Science degree which directly entitles to study towards a doctoral degree.

List of courses

Course contents

**Module A: Computer Science, Informatics**
- Introduction to Programming
- Computer Architecture and Networks
- Parallel Programming
- Programming of Supercomputers
- Software Engineering
- Scientific Visualization
- Fundamental Algorithms

**Module B: Applied Mathematics, Numerical Analysis**
- Numerical Analysis I (Basics and ODEs)
- Numerical Analysis II (PDEs and Finite Elements)
- Parallel Numerics

**Module C: Scientific Computing**
- Introduction to Scientific Computing
- Scientific Computing and Visualization (Practical course)

**Module D: Two Fields of Application (example)**
- Structural Dynamics
- Introduction to Finite Element Methods
- Computational Fluid Dynamics - Incompressible Flows
- Numerical Methods for the Simulation of Compressible Flows

**Seminar**

Profile of the Program

**Duration:** 4 semesters
**Degree:** Master of Science, Master of Science with Honours
**Start:** every winter term (mid October)
**Application Deadline:** March 31 for admission to the following winter term
**Application and Admission:** See this website>
**Costs per Semester:** student union fee + Basic semester ticket fee = 129.40€
**Language:** English

[Flyer Master Program >]

Master of Science with Honours

Together with its partner programs “Computational Mechanics” (at TUM) and “Computational Engineering” (at University Erlangen-Nuremberg), the CSE program forms the “Bavarian Graduate School of Computational Engineering”. Beginning in spring 2005, this association of master’s programs will offer an honours program funded by the Elite Network of Bavaria, an initiative by the Bavarian state government to promote highly qualified students.

The Bavarian Graduate School will offer additional courses to its most capable and dedicated students. The cornerstones of this elite program will be:

- extensive project work as a junior team in current research projects, or in cooperation with an
• summer/winter academies and block tutorials for a deeper understanding of your fields of interest.
• seminars on soft skills such as presentation and communication, teamwork, management and leadership, and related topics.
• Thus, the elite program strives to advance both the scientific education and the personal skills of the selected students. The extra effort – your outstanding performance in the CSE program assumed – will be rewarded by the academic degree of a Master of Science with Honours, which shall be a hallmark of outstanding achievement in your studies. For more details, see this website >

Application

Admission Requirements

To be eligible for the CSE Master’s Program, you need either

• an above-average bachelor’s degree, or
• diploma or master’s degree

from an internationally recognised university. As a graduate from a German Fachhochschule (or equivalent university) you will need an above-average master’s or diploma degree.

Typically, your degree should be from an engineering discipline or from one of the natural sciences. For admission, you must demonstrate a solid background in mathematics. In case of doubt, you may have to take a respective aptitude exam. Another requirement is proof of English proficiency (TOEFL or similar).

Applications

• A detailed application guide and the respective application forms are available on our website or from our contact address.
• Application deadline is March 31st for the following winter term.
• Admission decisions are made by the program’s board of examination before June 15.