ESPACE – Earth Oriented Space Science and Technology

International Master‘s Programm

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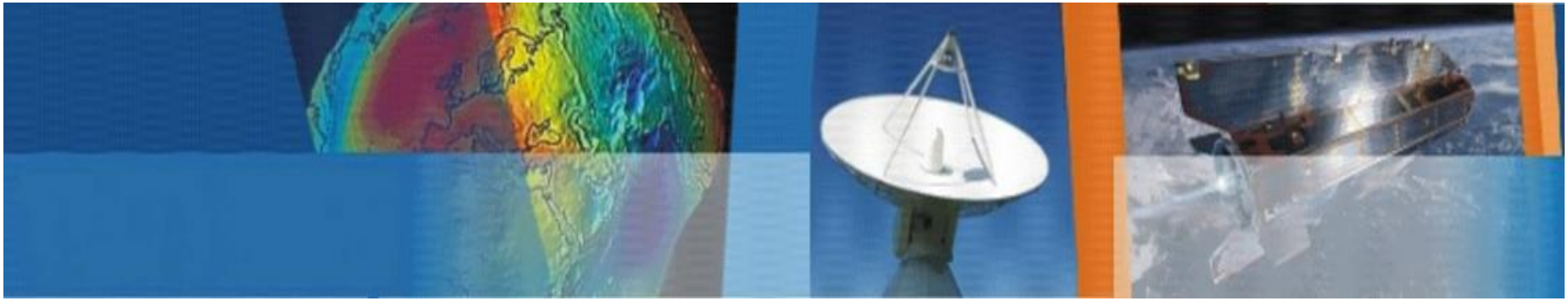


Background and objectives

Spacecraft Engineering

Studies: Aerospace Engineering

Satellite Data Users

Studies: Geodesy, Geophysics, Oceanography, Meteorology

Problem: Classical university programs cover parts of this spectrum in different disciplines → segregation of engineering and science

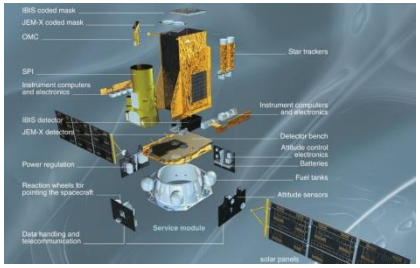
→ Master's program ESPACE combines spacecraft engineering with satellite applications in one interdisciplinary program

→ This combination makes ESPACE a unique study program in Europe

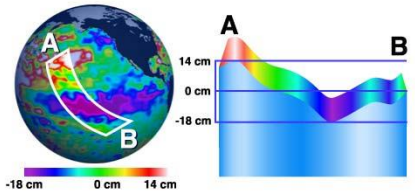
Earth Oriented Space Science and Technology - ESPACE

- **International Master's program (2 years):**
  - Graduates can be best described as **Satellite Application Engineers**
  - All lectures are in English
  - International environment with students from all over the world
  - Students can specialize in one of three satellite applications:
    - Earth System Science
    - Remote Sensing
    - Navigation

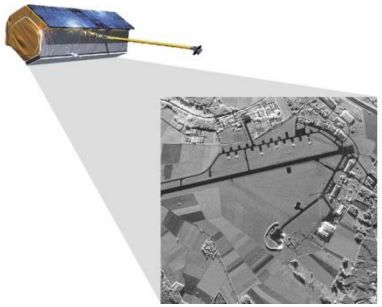
- **Target Group:**
  - Students from engineering programs such as aerospace, mechanical, electrical, communication, environmental, or science programs such as geodesy, as well as geophysics, physics or mathematics



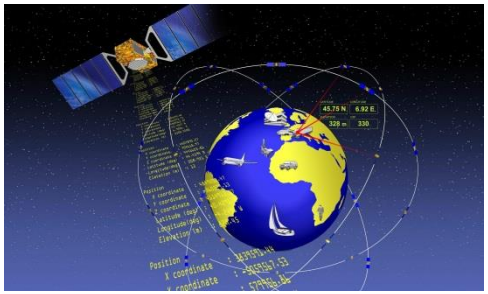
Spacecraft Engineering



Earth System Science



Remote Sensing



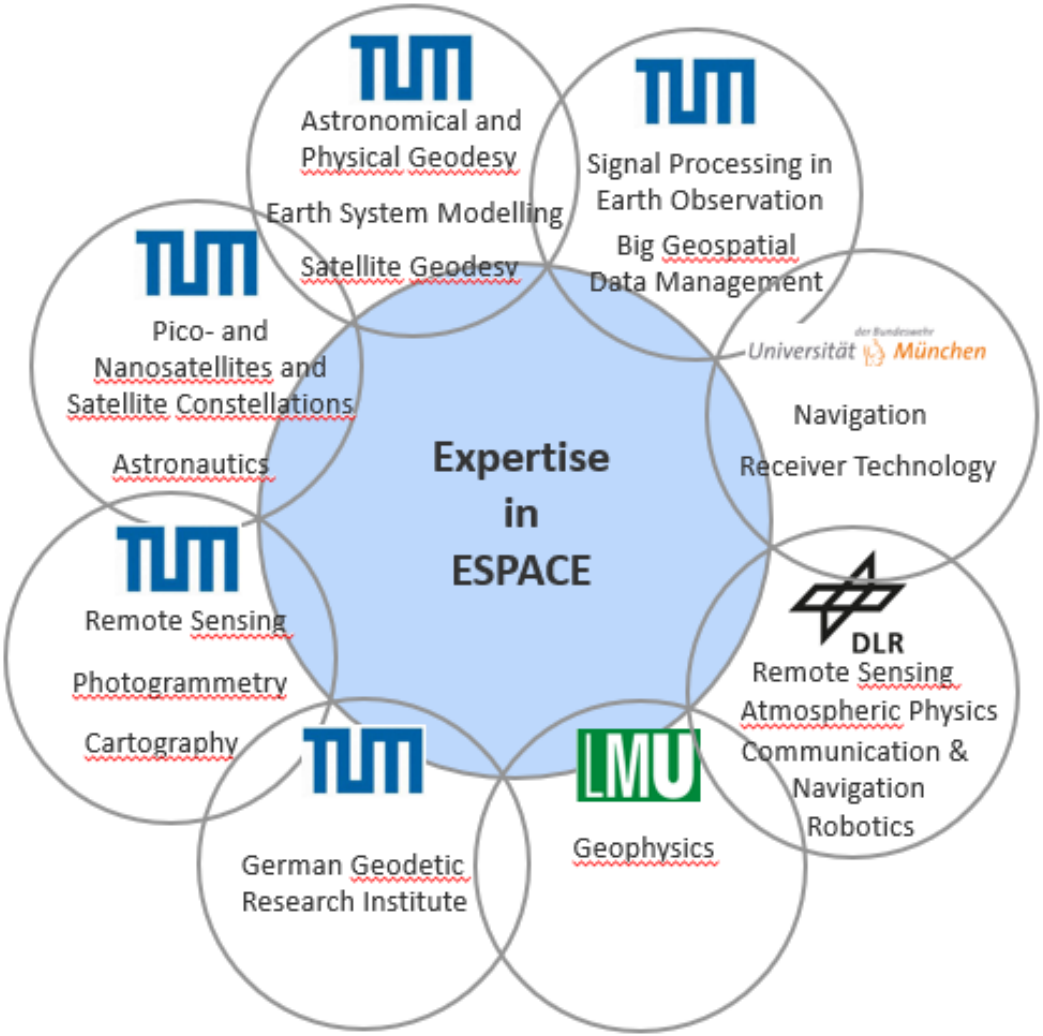
Navigation

ESPACE Cooperating Institutions

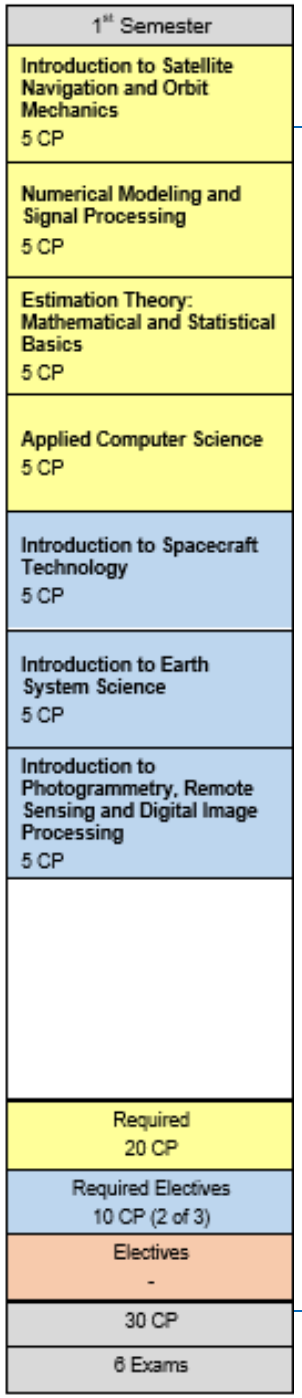
Munich has a unique concentration of know-how related to Space Science and Technology!

ESPACE is coordinated at the TUM with teaching staff from:

- **Universities**: TUM, Ludwig-Maximillian-Universität, University of Federal Armed Forces (Universität der Bundeswehr)
- **Research Institution:** German Aerospace Center (DLR), German Geodetic Reserach Institute (DGFI)



Curriculum


1st Semester
Introduction to Satellite Navigation and Orbit Mechanics
5 CP
Numerical Modeling and Signal Processing
5 CP
Estimation Theory: Mathematical and Statistical Basics
5 CP
Applied Computer Science
5 CP
Introduction to Spacecraft Technology
5 CP
Introduction to Earth System Science
5 CP
Introduction to Photogrammetry, Remote Sensing and Digital Image Processing
5 CP
Required
20 CP
Required Electives
10 CP (2 of 3)
Electives
-
30 CP
6 Exams

Curriculum

1st Semester	2nd Semester
Introduction to Satellite Navigation and Orbit Mechanics 5 CP	Project Seminar in Earth Oriented Space Science and Technology 5 CP
Numerical Modeling and Signal Processing 5 CP	Advanced Numerical Modeling and Signal Processing 5 CP
Estimation Theory: Mathematical and Statistical Basics 5 CP	Satellite Navigation and Advanced Orbit Mechanics 5 CP
Applied Computer Science 5 CP	Machine Learning for Earth Observation 5 CP
Introduction to Spacecraft Technology 5 CP	Advanced Spacecraft Technology 5 CP
Introduction to Earth System Science 5 CP	Ground and Space Mission Elements 5 CP
Introduction to Photogrammetry, Remote Sensing and Digital Image Processing 5 CP	Advanced Remote Sensing 5 CP
	Earth System Modelling 5 CP
	Free Electives 5 CP
Required 20 CP	Required -
Required Electives 10 CP (2 of 3)	Required Electives 25 CP (5 of 8)
Electives -	Electives 5 CP
30 CP	30 CP
6 Exams	6 Exams

Curriculum

1st Semester	2nd Semester	3rd Semester
Introduction to Satellite Navigation and Orbit Mechanics 5 CP	Project Seminar in Earth Oriented Space Science and Technology 5 CP	Specialization (see separate figure) 15 CP
Numerical Modeling and Signal Processing 5 CP	Advanced Numerical Modeling and Signal Processing 5 CP	
Estimation Theory: Mathematical and Statistical Basics 5 CP	Satellite Navigation and Advanced Orbit Mechanics 5 CP	
Applied Computer Science 5 CP	Machine Learning for Earth Observation 5 CP	Satellite Mission Design Project 5 CP
Introduction to Spacecraft Technology 5 CP	Advanced Spacecraft Technology 5 CP	Interdisciplinary Electives 10 CP
Introduction to Earth System Science 5 CP	Ground and Space Mission Elements 5 CP	
Introduction to Photogrammetry, Remote Sensing and Digital Image Processing 5 CP	Advanced Remote Sensing 5 CP	
	Earth System Modelling 5 CP	
	Free Electives 5 CP	
Required 20 CP	Required -	Required 5 CP
Required Electives 10 CP (2 of 3)	Required Electives 25 CP (5 of 8)	Required Electives 15 CP
Electives -	Electives 5 CP	Electives 10 CP
30 CP	30 CP	30 CP
6 Exams	6 Exams	6 Exams

Curriculum

1st Semester	2nd Semester	3rd Semester	4th Semester
Introduction to Satellite Navigation and Orbit Mechanics 5 CP	Project Seminar in Earth Oriented Space Science and Technology 5 CP	Specialization (see separate figure) 15 CP	Master's Thesis Master's Colloquium 30 CP
Numerical Modeling and Signal Processing 5 CP	Advanced Numerical Modeling and Signal Processing 5 CP		
Estimation Theory: Mathematical and Statistical Basics 5 CP	Satellite Navigation and Advanced Orbit Mechanics 5 CP		
Applied Computer Science 5 CP	Machine Learning for Earth Observation 5 CP	Satellite Mission Design Project 5 CP	
Introduction to Spacecraft Technology 5 CP	Advanced Spacecraft Technology 5 CP	Interdisciplinary Electives 10 CP	
Introduction to Earth System Science 5 CP	Ground and Space Mission Elements 5 CP		
Introduction to Photogrammetry, Remote Sensing and Digital Image Processing 5 CP	Advanced Remote Sensing 5 CP		
	Earth System Modelling 5 CP		
	Free Electives 5 CP		
Required 20 CP	Required -	Required 5 CP	Required 30 CP
Required Electives 10 CP (2 of 3)	Required Electives 25 CP (5 of 8)	Required Electives 15 CP	Required Electives -
Electives -	Electives 5 CP	Electives 10 CP	Electives -
30 CP	30 CP	30 CP	30 CP
6 Exams	6 Exams	6 Exams	1 Exam

Specialization in the 3. semester

3rd Semester - Themes of Specialization		
Earth System Science from Space	**Remote Sensing**	**Navigation**
Atmosphere and Ocean 5 CP	**Geoinformation** 5 CP	**Precise GNSS and Inertial Navigation** 5 CP
Geokinematics and Continental Hydrology 5 CP or **Advanced Earth System Modeling and Continental Hydrology** 5 CP	**Photogrammetry – Selected Chapters** 5 CP	**Advanced Aspects of Navigation Technology** 5 CP
Space-based Gravity and Magnetic Field Monitoring 5 CP	**Remote Sensing** 5 CP	**Navigation Labs** 5 CP
15 CP	15 CP	15 CP
3 Exams	3 Exams	3 Exams

Specialization in the 3. semester

Core Theme & Modules	Type	Semester
Mathematical Foundations		
Numerical Modelling and Signal Processing	required	1
Estimation Theory and Statistical Basics	required	1
Advanced Numerical Modeling and Signal Processing	required elective	2

Specialization in the 3. semester

Core Theme & Modules	Type	Semester
Mathematical Foundations		
Numerical Modelling and Signal Processing	required	1
Estimation Theory and Statistical Basics	required	1
Advanced Numerical Modeling and Signal Processing	required elective	2
Aerospace		
Introduction to Spacecraft Technology	required elective	1
Advanced Spacecraft Technology	required elective	2
Ground and Space Mission Elements	required elective	2
Satellite Mission Design Project	required	3

Specialization in the 3. semester

Core Theme & Modules	Type	Semester
Mathematical Foundations		
Numerical Modelling and Signal Processing	required	1
Estimation Theory and Statistical Basics	required	1
Advanced Numerical Modeling and Signal Processing	required elective	2
Aerospace		
Introduction to Spacecraft Technology	required elective	1
Advanced Spacecraft Technology	required elective	2
Ground and Space Mission Elements	required elective	2
Satellite Mission Design Project	required	3
Orbits, Navigation & Computer Science		
Introduction to Satellite Navigation and Orbit Mechanics	required	1
Applied Computer Science	required	1
Satellite Navigation and Advanced Orbit Mechanics	required elective	2
Specialization	required elective	3

Specialization in the 3. semester

Core Theme & Modules	Type	Semester
Mathematical Foundations		
Numerical Modelling and Signal Processing	required	1
Estimation Theory and Statistical Basics	required	1
Advanced Numerical Modeling and Signal Processing	required elective	2
Aerospace		
Introduction to Spacecraft Technology	required elective	1
Advanced Spacecraft Technology	required elective	2
Ground and Space Mission Elements	required elective	2
Satellite Mission Design Project	required	3
Orbits, Navigation & Computer Science		
Introduction to Satellite Navigation and Orbit Mechanics	required	1
Applied Computer Science	required	1
Satellite Navigation and Advanced Orbit Mechanics	required elective	2
Specialization	required elective	3
Earth System Science from Space		
Introduction to Earth System Science	required elective	1
Project Seminar in ESPACE	required elective	2
Earth System Modelling	required elective	2
Specialization	required elective	3

Specialization in the 3. semester

Core Theme & Modules	Type	Semester
Mathematical Foundations		
Numerical Modelling and Signal Processing	required	1
Estimation Theory and Statistical Basics	required	1
Advanced Numerical Modeling and Signal Processing	required elective	2
Aerospace		
Introduction to Spacecraft Technology	required elective	1
Advanced Spacecraft Technology	required elective	2
Ground and Space Mission Elements	required elective	2
Satellite Mission Design Project	required	3
Orbits, Navigation & Computer Science		
Introduction to Satellite Navigation and Orbit Mechanics	required	1
Applied Computer Science	required	1
Satellite Navigation and Advanced Orbit Mechanics	required elective	2
Specialization	required elective	3
Earth System Science from Space		
Introduction to Earth System Science	required elective	1
Project Seminar in ESPACE	required elective	2
Earth System Modelling	required elective	2
Specialization	required elective	3
Photogrammetry & Remote Sensing		
Introduction to Photogrammetry, Remote Sensing & Digital Image Processing	required elective	1
Machine Learning for Earth Observation	required elective	2
Advanced Remote Sensing	required elective	2
Specialization	required elective	3

ESPACE inter-cultural and social events

Excursion to Geodetic Observatory Wettzell

Christmas party with students & lecturers

- Orientation Week for first semester students
  → week before start of the lecture period in winter semester
- Buddy Meeting with previous ESPACE batches
- …

ESPACE Double Degree with Wuhan University, China

- Two Master‘s degrees:
  - one from TUM
  - one from Wuhan University (WHU)
- Duration: 3 years (one more year than regular ESPACE Master‘s program)
- First year at TUM, second year at WHU, third year at TUM
- Funding possibilities

1:1 Program with Technical University of Denmark (DTU)

One year study visit at one of the leading technical universities in Europe

- Duration: 2 years (as regular Master's program in ESPACE)
- First year – at TUM
- Exchange in 2nd year of Master's Program to DTU
- funding via Erasmus+
- Master of Science (TUM) + transcript from DTU

1st semester, TUM – ESPACE	2nd semester, TUM – ESPACE
Regular study program (30 ECTS)	Regular study program (30 ECTS)
3rd semester, Fall at DTU	4th semester, Spring at DTU
Compulsory: 15 ECTS Required electives: At least 10 ECTS Electives: Up to 5 ECTS	Co-supervised Master's Thesis (30 ECTS)

Activities beyond ESPACE study program at TUM

MOVE-III

- Development of 6U CubeSat for detection and identification of sub-millimeter space debris particles
- https://warr.de/en/projects/move/move-iii/

Astronomy Club

- **Observatory at TUM Main Campus**
- https://www.asg.ed.tum.de/fesg/astronomy-club/

Application

Application period: January 1 to May 31

Aptitude assessment for all students

- Documents:
  - Statement of purpose (motivation letter)
  - short self-written essay (500 – 700 words)
  - Transcript of records (at least 140 ECTS)
  - English language certificate
- Competencies in mathematics, physics and computer science
  → well-known foundations in BA Aerospace

No tuition fees since Bachelor‘s degree obtained at TUM

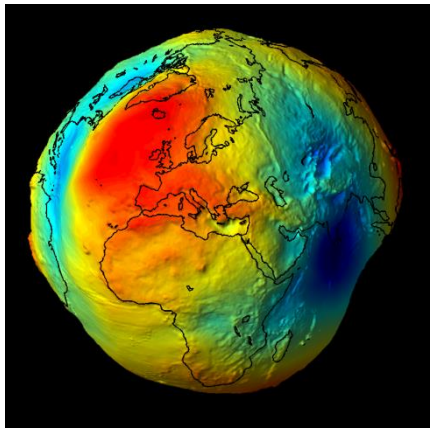
Contact Information

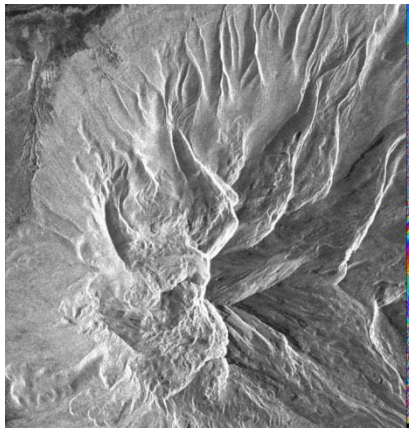
ESPACE Website:

https://collab.dvb.bayern/display/TUMedschooloffice/M.Sc.+ESPACE+-+Earth+Oriented+Space+Science+and+Technology

Questions?

info@espace-tum.de






Thank you very much for your attention!