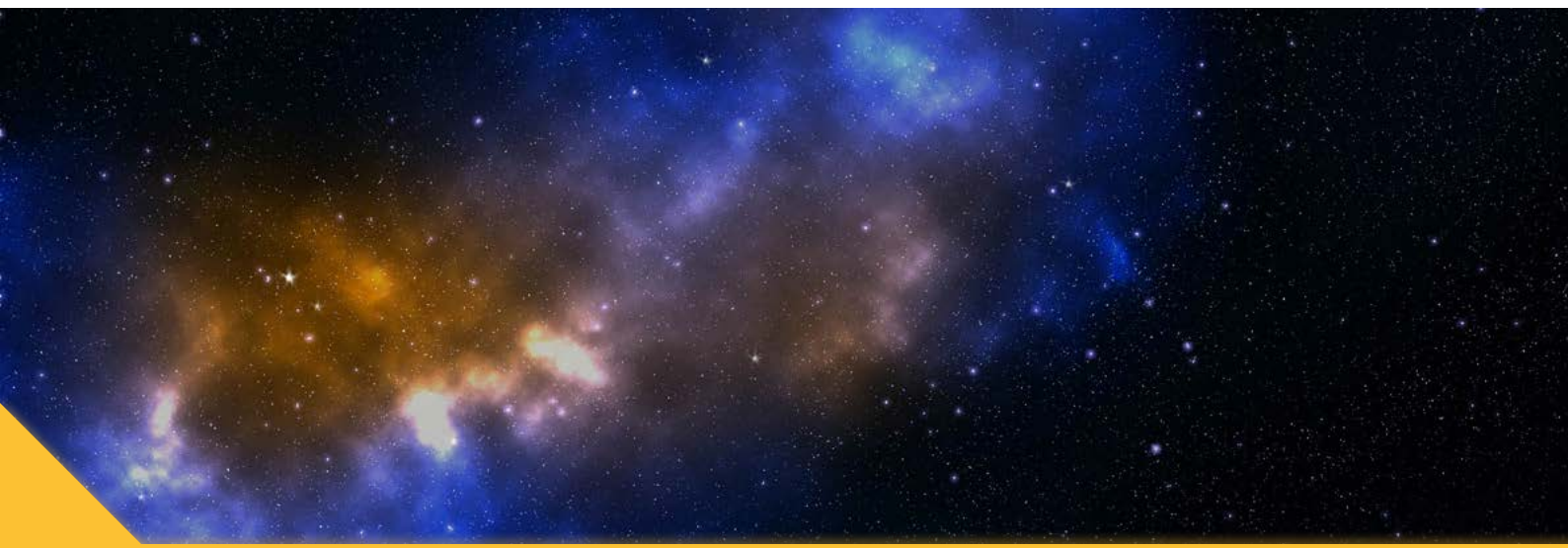




Training & Consulting





Training & Consulting

The German Space Operations Center (GSOC), operated by the German Aerospace Center (DLR), is the central institution for spaceflight operations in Germany and has successfully operated space missions since 1969. In more than 60 space missions, DLR has proven its expertise in spacecraft operations with many different applications. This includes satellite missions for Earth observation, science and communication missions as well as the exploration of the solar system and human spaceflight missions. These missions are monitored and controlled from a flexible and reliable multi-mission operations environment in its control center at Oberpfaffenhofen.

GSOC has shaped space operations nationally and internationally, is member of various standardization committees, initiator of the "SpaceOps" conference and publisher of the book "Spacecraft Operations", which is dedicated exclusively to operations.

With this background, we offer our annual Spacecraft Operations Course as well as specific and individual trainings, tailored to the customers' needs. Customers and partners can also book individual trainings. In close coordination with our training team, we offer personalized courses for individuals or small groups. We design our course modules regarding to specific customer profiles.

Furthermore, we offer individual consulting packages for certain projects, e.g., for LEOP Mission and Flight Dynamics Services. They come with participation of senior matter experts in review boards or on-site support at the customers' premises by GSOC personnel.

Our services

- Spacecraft Operations Course
- Specific trainings
- Consulting packages, tailored to the customers' needs

Point of Contact

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2. Spacecraft Operations Course

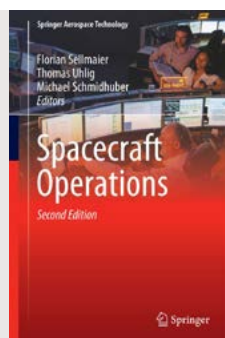
The experience of the German Space Operations Center (GSOC) dates back to the late 1960s. With more than 70 successful missions, GSOC has developed into one of the leading centers for space missions in Europe. Since early 2000, GSOC has decided to share this experience and offers an annual course on satellite operations. The “Spacecraft Operations Course” presents an integrated approach to spacecraft operations by providing an insight into the operation of the various satellite subsystems and their interaction with each other. Through a series of lectures and hands-on trainings, this course gives a detailed overview of how to plan, prepare and perform spacecraft operations. Many operational aspects are addressed, including the relevant tools, procedures and the experience gained in numerous spacecraft missions at GSOC. The course is aimed at a wide range of participants involved in space operations, including manufacturers, users, insurers and operators.

More specific courses can be developed on request (see below).

Course Manual published as book

The book describes the basic concepts of spaceflight operations for both human and unmanned missions. It will be made available to course participants as handout material.

- Bound Edition: 595 pages
- Publisher: Springer; 2nd edition: 2022
- Language: English
- Ebook: ISBN 978-3-030-88593-9
- Hardcover book: ISBN 978-3-030-88592-2



2.1 Course Content

The German Space Operations Center has developed this course addressing all aspects of satellite operations and corresponding ground segment design. The course is intended for a maximum number of 18 participants and is held once or twice a year, usually in April and/or October.



Fig. 2-1 Ground Operations Control Room (GoCR)

The following subjects and topics will be addressed in the GSOC Spacecraft Operations Course:

Flight Dynamics	<ul style="list-style-type: none"> – Orbit Aspects – Attitude Aspects
Mission Planning	<ul style="list-style-type: none"> – Concepts and Methods – Application
Satellite Operations	<ul style="list-style-type: none"> – Project Management – Mission Operations, Preparation and Execution – Selected Operational Aspects of Satellite Subsystems Operations <ul style="list-style-type: none"> – Telemetry, Command & Ranging and Data Handling Subsystem Operations – Attitude and Orbit Control Subsystem Operations – Propulsion Subsystem Operations – Power and Thermal Subsystem Operations – Repeater and Scientific Instruments Subsystem Operations – Flight Experience – System Aspects
Human Spaceflight Mission Operations	<ul style="list-style-type: none"> – ISS-Columbus Operations
Lessons by External Partners	<ul style="list-style-type: none"> – Space Environment – Satellite Design – Interplanetary Mission Operations – Cubesat Operations
Ground Segment	<ul style="list-style-type: none"> – Ground Station Networks – Ground Station Design & Ops – Satellite Control Center
On-console Trainings	<ul style="list-style-type: none"> – Control Room – Flight Dynamics – Mission Planning – Flight Procedure Generation – Voice Communications – Flight Simulation
Site-Tours	<ul style="list-style-type: none"> – GSOC control and system rooms – Weilheim Ground station



2.2 Course Schedule

The course starts on Monday at 09:00 and finishes on Friday 16:00. Lectures are typically held between 09:00 and 16:00. There is a lunch break between 12:15 and 13:30. Hands-on trainings are conducted from 16:15 to 17:30. A welcome cocktail and social event are planned for Monday evening and Thursday evening, respectively.

	Monday						Tuesday						Wednesday						Thursday						Friday																									
Time	9	10	11	12	13	14	15	16	17	18	9	10	11	12	13	14	15	16	17	18	9	10	11	12	13	14	15	16	17	18	9	10	11	12	13	14	15	16	17	18	9	10	11	12	13	14	15	16	17	18
	The course starts on Monday at 09:00 and finishes on Friday 16:00 hours.																															
Lectures	—						—						—						—						—																									
Hands-on trainings							—												—																															
Time	18	19	20	21	22	23	18	19	20	21	22	23	18	19	20	21	22	23	18	19	20	21	22	23	18	19	20	21	22	23																				
Welcome Cocktail & Social Event	—																		—																															

2.3 Practical Aspects

The course language is English.

The course starts with registration and an introduction on Monday morning. Most lectures take place at the German Space Operations Center, Oberpfaffenhofen, in a designated lecture room and in GSOC control rooms. All attendees will receive a comprehensive set of course documentation.

On Wednesday morning, a lecture and a tour will be given at DLR's ground station located at Weilheim, 45 minutes south of Oberpfaffenhofen.

The Oberpfaffenhofen site of DLR is located approx. 25 km west of Munich, Germany. Please check the map for more details. Accommodation is available in the area around Oberpfaffenhofen or in downtown Munich. Attendees should make their own arrangements, but support is available.



Fig. 2-2 GSOC, Oberpfaffenhofen



Fig. 2-3 Ground Station located at Weilheim

2.4 Application Details

Course Fee: 2.700,- Euro

The course fee also includes:

- Welcome cocktail on Monday
- Comprehensive course documentation (Hardcover book "Spacecraft Operations", 2nd edition)
- Catering provided
- Bus transfer between Oberpfaffenhofen and Weilheim
- Social event (dinner)

Please check our website for the next course date:

www.dlr.de/rb/soc

The closing date for applications is announced on our website

(selection on a 'first come – first served' basis).

Maximum number of attendees: 18

Please contact the organizers for further information: soc@dlr.de

Organized by Florian Sellmaier & Michael Schmidhuber



2.5 Exemplary Schedule of the Spacecraft Operations Course

	Monday	Tuesday	Wednesday	Thursday	Friday	
08:00 - 08:30			Bus transfer from Oberpfaffenhofen to Weilheim			
08:30 - 09:00	Registration					
09:00 - 09:30	Welcome & Introduction	AOCS Operations	Ground Station Design & Operations	Power/Thermal	Interplanetary Operations (ESOC)	
09:30 - 10:00						
10:00 - 10:30	Mission Operations Preparation	Orbital Dynamics	Tour at Weilheim Ground Station (10:00 - 11:45)	Human Spaceflight Operations	Simulation	
10:30 - 11:00						
11:00 - 11:30	Mission Operations Execution	Attitude Dynamics	Bus transfer to Oberpfaffenhofen	CubeSat Operations (CNES)		
11:30 - 12:00						
12:00 - 12:30	Lunch	Lunch	Lunch	Lunch		
12:30 - 13:00						
13:00 - 13:30	Tour at Oberpfaffenhofen Control Center	Course Intro	VoCS Training	SIM Intro		
13:30 - 14:00		FOP Exercise				
14:00 - 14:30				Flight Dynamics (Team 1)	Flight Dynamics (Team 2)	Closing Remarks
14:30 - 15:00	Ground Data Systems	Mission Planning (Team 2)				
15:00 - 15:30					Mission Planning (Team 1)	
15:30 - 16:00						
16:00 - 16:30	Space Environment					
16:30 - 17:00						
17:00 - 17:30	Flight Procedures	Mission Planning	Repeater Ops	On-Orbit Servicing		
17:30 - 18:00						
18:00 - 18:30	Welcome Cocktail					
18:30 - 19:00						
19:00 - 19:30					Social Event	
19:30 - 20:00						
20:00 - 20:30						
20:30 - 21:00						
21:00 - 21:30						
21:30 - 22:00						



3. Specific Training Courses



Fig. 3-1 Control Room K2 - Mission TanDEM-X

Based on the Spacecraft Operations Course we offer customized trainings. The format can be expanded or compressed; the depth can be adjusted from overview to detailed training. Some modules can be held at the customer's site and for a larger audience.

Typically, courses include the following elements, which can be more or less expanded as needed:

- Overview lectures
- Special lectures
- Guided tours
- On-console training
- Exercises
- Q&A sessions with experts

All training courses are available in German or English. Depending on the extent of the necessary adjustments, a longer preparation time may be required.

We also offer a range of training modules to universities. They can be embedded in the form of excursions, practical exercises and guest lectures. Depending on the format, the content can be presented on the university campus or in the control center.



3.1 Compact Courses

Our compact courses usually take place in two days and require little previous knowledge in the field of space operations. Nevertheless, participants should have a basic technical understanding of general space technology concepts. They get an overview of the necessary knowledge in the specific fields. In exercises and simulations, the participants work on console themselves. The guided tours and project visits put them in direct contact with the missions operated at GSOC.



Fig. 3-2 Typical GSOC-OP mission control room (K4)

The agenda also includes a summary of the European and German space facilities and their expertise. A question and answer session at the end of each day offers opportunities to discuss individual topics and to involve experts.

Example for a two-day compact course:

Time	Day 1	Day 2
9:00-12:00	<ul style="list-style-type: none"> - Introduction - Space Environment - Space Segment - Project Management 	<ul style="list-style-type: none"> - Space Missions in German and European Institutions & their Competencies - Mission Operations Software - Ranging & Flight Dynamics
13:00-18:00	<ul style="list-style-type: none"> - Mission Procedures - Mission Planning - Guided Tour at GSOC - Exercises - Questions & answers 	<ul style="list-style-type: none"> - Flight Experience - Security Aspects - Simulation - Questions & Answers

3.2 Intensive Training

Our intensive training modules are aimed at people who want to learn about satellite operations in detail and who are then ready to participate in actual operations under supervision. If possible, the participants should already have attended the modules "Mission Operations" and "Space Segment".

The intensive training lasts two weeks and should, if possible, be completed in one go. The first week offers a series of lectures, which are lightened up by small exercises and guided tours. The participants get to know each other and also get to know the control center. Topics include the fundamentals of spaceflight, project management, elements of the space and ground systems, methods and tools of flight operations, operational aspects of satellite subsystems, mission planning and space flight dynamics. In the second week the knowledge is put into practice. In teams and with distributed roles, the participants prepare a mission in detail, which is then performed on the simulator. The course also includes a trip to the DLR ground station in Weilheim to get a first insight of the antenna equipment.

Example for an intensive training:

Time	Day 1	Day 2	Day 3	Day 4	Day5
Week 1	<ul style="list-style-type: none"> - Introduction - Mission Operations, Preparation and Execution 	<ul style="list-style-type: none"> - Lectures - Exercise 1: Consoles 	<ul style="list-style-type: none"> - Lectures - Exercise 2: Mission Planning 	<ul style="list-style-type: none"> - Lectures - Exercise 3: Flight Dynamics 	<ul style="list-style-type: none"> - Lectures
Week 2	<ul style="list-style-type: none"> - Preparation Flight Procedures and Data Handling 	<ul style="list-style-type: none"> - Preparation Mission Planning 	<ul style="list-style-type: none"> - Tour at Weilheim Ground Station 	<ul style="list-style-type: none"> - Integrated Simulation Day 1 	<ul style="list-style-type: none"> - Integrated Simulation Day 2



4. Consulting

This service aims at customers new or relatively new to the field of spacecraft operations or to those wanting to expand existing technical capabilities. Based on our experience of more than five decades in satellite control and space mission operations in general, GSOC offers technical consulting across every affected discipline, e.g., **satellite operations and operations preparation; ground segment system design, implementation and operation; flight dynamics services; monitoring and control software systems development and configuration as well as control center infrastructure.**

Individual consulting packages can be tailored specifically to the customer's needs, ranging from consulting and training at GSOC premises, participation of senior matter experts in review boards, to on-site support at the customer's premises by GSOC personnel.

Five decades of experience in:

- Satellite Control
- Space Mission Operations
- Satellite Operations and Operations Preparation
- Ground Segment System Design
- Flight Dynamics Services
- Monitoring and Control Software Systems Development and Configuration
- Control Center Infrastructure

Individual consulting and training packages:

- Tailored specifically to the customer's needs
- Consulting and training at GSOC premises
- Participation of Senior Matter Experts in review boards, to On-Site Support at the customer's premises by GSOC personnel

