Course name: Concurrent Engineering of Space Missions

Teacher: Jean-Paul Kneib (David Rodríguez)

Language: English

Basic info

Credits: 2
Semester: Spring 2022/23
Exam: Oral
Workload: 60 h
Weeks: 2
Lecture: 8h total over 2 weeks
Practical work: 50h (40h/week long intensive workshop + 10 h debriefs and final presentation/exam)
Number of positions: max 20, min 8.

Summary

The main objective of this course is to teach the students the fundamentals of concurrent engineering for space missions and systems. The course is built around a similar framework to that of the European Space Agency's (ESA) Concurrent Engineering Challenge. Students will be split in two teams and design a space mission together in an intensive 2-week-long workshop, using the tools & process of Concurrent Engineering. During the course they will be at all times supported by experts from eSpace. This is a cooperative challenge, meaning teams will share progress at the end of every day. Course ends with a final presentation of the mission designed by each team. By the end of the course students shall become familiar with the foundation, benefits, and application of concurrent engineering practices when applied to solving complex engineering problems.

Content

Introduction

- What is concurrent engineering?
- Introduction to common concurrent engineering practices and tools.
- Target mission design: mission overview, science objectives, and high-level requirements.

Practical engineering of a space mission

- Primer on the space environment & spacecraft subsystems. Students form teams of 10 and are individually assigned to a given subsystem based on their competencies & interests. The involved disciplines include: structures & mechanisms, configuration, power, thermal, AOCS, propulsion, trajectory analysis, communication & data handling, and systems engineering.

Concurrent & Systems Engineering techniques in action

- Real-time concurrent engineering processes, including: mission phases & modes definition, identification & resolution of key design trade-offs; design budgets; product tree; design iterations; preliminary subsystem design; trades between subsystems.

Engineering teamwork

- Structured, intensive collaboration within and between engineering disciplines to rapidly design, in a realistic environment with tooling. Leadership & interpersonal skills, including presentations to peers & expert review, and their impact on design process success.

Keywords
concurrent engineering, concept design, systems engineering, space exploration, space system, space environment, engineering teamwork

Learning Prerequisites

Required courses

- Space mission design and operations (EE-585) Prof. Claude Nicollier (already taken or have registered for)

Recommended courses

- Spacecraft design and system engineering (EE-584) Prof. Bernard Foing
- Fundamentals in systems engineering (ENG-421) Prof. Olivier de Weck

Some practical engineering team project experience.

Learning Outcomes
By the end of the course, the student must be able to:

- Understand and participate in Concurrent Engineering
- Understand and participate in space mission design
- Rapidly dimension their chosen subsystem, and understand its impact on system design
- Design their subsystem in the frame of rapid, collaborative design
- Negotiate subsystem trade-offs & communicate key concerns to system level
- Participate in real-time engineering discussion
- Contribute to a coherent system design

Transversal skills

- Set team objectives and design an action plan to reach those objectives via teamwork
- Plan and carry out team activities in a way which makes optimal use of available time and other resources, under tight constraints
- Lead & participate in productive engineering discussion
- Access and evaluate appropriate sources of information in real-time
- Write a scientific or technical report

Expected student activities
Design work during intensive workshop, final presentation & report.

Assessment methods
final report and presentation.

Supervision
Office hours Yes
Assistants Yes

Resources

Bibliography

- "Space Mission Analysis and Design", by W. Larson and J. Wertz
- eSpace Concurrent Engineering Wiki

Ressources en bibliothèque

- Space Mission analysis and Design / Larson

In the press

- eSpace hosts students for Concurrent Engineering Challenge