ENG-411

Concurrent engineering of space missions

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA2, MA4	Opt.
Space technologies minor	E	Opt.
Systems Engineering minor	E	Opt.

Language of teaching	English
Credits	2
Session	Summer
Semester	Spring
Exam	During the semester
Workload	60h
Weeks	14
Hours	**4 weekly**
Courses	1 weekly
TP	3 weekly
Number of positions	

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.

Content

- **Note: Up to date information about this course can be found in https://cdf.epfl.ch/en/eng411.**
- **Please note that this class has conditions to actually happen: we need a minimum of 8 students, and a maximun of 15 students.**

Students are teamed up to design a space mission together, using the tools & process of Concurrent Engineering. During the course they will be at all times supported by experts from EPFL Space Center.
This is a cooperative challenge, meaning team members will share progress at the end of every day and collaborate to design a mission or system. Course ends with a final presentation of the mission/system designed by the 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.
Important! Availability for half a day during the design sessions is required to fulfill the course requirements.
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 a team 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, sustainability, 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

Spacecraft design and systems engineering (EE-584)

Recommended courses

Space mission design and operations (EE-585)
**Fundamentals in systems engineering (ENG-421) [if available]

Prior practical engineering team project experience is recommended

Learning Outcomes

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

- Perform concurrent engineering
- Coordinate with other students to design a coherent space mission
- Design a spacecraft sub system and understand its impact on system design
- Create a new mission in the frame of rapid, real time collaborative design
- Negotiate sub system tradeoffs and communicate key concerns to system levels

Transversal skills

- Write a scientific or technical report.
- Access and evaluate appropriate sources of information.
- Set objectives and design an action plan to reach those objectives.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Communicate effectively with professionals from other disciplines.
- Resolve conflicts in ways that are productive for the task and the people concerned.

Teaching methods

- Given during the first 7 weeks of the semester

- Project-based learning

Expected student activities

Design work during intensive workshop, final presentation & report.

Assessment methods

Final grade is based on five elements: an intermediate team presentation of the mission, final team report and presentation, presence to the design sessions, and team mates assessment.

Supervision

Office hours	No
Assistants	Yes
Forum	Yes

Resources

Bibliography

Bibliography:

- "Space Mission Analysis and Design", by W. Larson and J. Wertz.
- "Spacecraft Systems Engineering", by Fortescue, Stark, Swinerd.
- EPFL Space Center's Concurrent Engineering Wiki

Ressources en bibliothèque:

- Space Mission analysis and Design / Larson

In the press:

- eSpace hosts students for Concurrent Engineering Challenge

Websites:

- https://cdf.epfl.ch/

Moodle Link

- https://go.epfl.ch/ENG-411