Earth Observation mission built by a student community

Department of Radio Science and Engineering
Aalto University
Dream of own satellite 2010
How to build a satellite?
Satellite project integration to curriculum

- The satellite project was integrated with Master thesis projects and special assignments
- The project worked together with many teachers in many disciplines
- The satellite project provided topics in:
  - remote sensing, space technology, radio engineering, electronics, mechanical engineering, software engineering and others
Typical thesis projects
Systems engineering challenges in a student project
Tailored documentation approach for student projects

A documentation approach was developed which includes systems engineering, supervising and assessment.
Student workshops and courses
The Finnish Student Satellite

Sun sensor calibration measurements

Aalto University

Aalto-1
The Finnish Student Satellite
Aalto-1 CubeSat project timeline

- Concept
- Preliminary design
- Design
- Manufacturing
- Testing
- Launch

- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
Multi Payload, technology demonstration
Mass: 4 kg
COM: 437 kHz and 2405 kHz
Payloads

**AaSI (VTT)**
Mass: 592 g
Power: max 2.5 W

**Plasma Brake (FMI)**
Mass: 259 g
Power consumption: 1-1.6 W
1000 V high voltage generation

**RADMON (Univ. Of Turku, Univ of Helsinki)**
Particle detector measuring the flux of >700 keV electrons and >10 MeV proton
Mass: 354 g
Power consumption: 1 W
Earth Observation payload
AaSI – Fabry-Perot Spectral Imager

Fully adjustable spectral band configuration

Mass 592 g
Dimensions: Compatible
Power consumption:
  +5V: 1.1 W - 2.1 W
  +12V: 0.2 W - 0.4 W
Ground resolution 200 m
Spectral resolution < 20 nm
Spectral range 500 – 900 nm
Vegetation reflectance

Spectral imager
Aalto-1 team is preparing for launch

Aalto-1 is booked to SpaceX launch with Falcon 9
Launch is expected in the beginning of 2016
Core team has been around 20 students every year
Educational results

During 6 years of the project

• ~100 students participated
• ~70 students made special assignments in satellite project
• 28 Bachelor theses were written on satellite related topics
• 11 Master theses on Aalto-1 satellite
• 9 Master theses on related topics
• (additional 10 Master theses on RADMON instrument in Univ. of Turku and Univ. of Helsinki)
• 12 students proceeded to doctoral studies

• ~20 conference papers by students
• 3 published journal publications
CubeSat generation skillset

- Project working skills
- Practical problem solving skills
- Good technical ability in engineering
- Fascinated by space technology
- Good connection to international community
- Good connection to industry
- Entrepreneur minded

CubeSat generation wants to build more satellites
An satellite EO spin-off company founded by project students
Future

The Aalto-1 is waiting for launch – the CubeSat generation is looking for new challenges

Coming changes
• Amount of EO satellites will increase rapidly
• Small EO platforms and low orbits will commercialize
• Space debris will be an increasing problem
• New, innovative EO consumer products
• Temporal coverage will increase
• New concepts, big data, sensor networks
Conclusions

A CubeSat project is a wonderful tool to inspire and empower the students

Pros
• CubeSat suits well for project based teaching
• CubeSat project creates strong student community
• Enforces interdisciplinary cooperation in teaching
• Project provides students with connections to science and industry
• Entrepreneur-spirited

Cons
• Launch is still expensive
• Timeframe for teaching project should be shorter
Thank you!