Nanosatellites and space technology education in Finland

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Department of Radio Science and Engineering
Aalto University
Full member of ESA for 19 years

Soho (1995)
Cassini-Huygens (1997)
XMM-Newton (1999)
Proba (2001)
Cluster-II (2002)
Envisat-1 (2002)
Integral (2002)
MSG (2002)
Mars Express (2003)
Smart-1 (2003)
Rosetta (2004)
Venus Express (2005)
Galileo (2005 & 2008)
Goce (2009)
Planck (2009)
Herschel (2009)
SMOS (2009)
Cryosat 2 (2009)
ADM-Aeolus
SWARM
BepiColombo
Space topics at Finnish Universities

• Aalto University
  – Space Technology and Science
  – Robotics
  – Erasmus Mundus SpaceMaster programme

• Helsinki University
  – Master’s Degree Programme in Space Sciences

• University of Turku and Tuorla Observatory
  – Astronomy and space physics

• University of Oulu
  – Space physics

• Tampere Technical University
  – Some courses in Space Technology
Aalto starts new Master programmes in 2015

A new Master programme on **Nano and Radio Sciences** starts in autumn **2015**.

- New **Space Sciences and Technology** Major.
- Tight integration with radio- and nanosciences.
- Collaboration with Joint European ERASMUS MUNDUS Space Master programme.
- Collaboration with Nordic Five Tech.
New professors on Space topics at Aalto University Department of Radio Science and Engineering
Tuija Pulkkinen

Space Science
Esa Kallio

Space Science and Technology
Anne Lähteenmäki

Radio Astronomy
Jaan Praks

Microwave Remote Sensing

The Finnish Student Satellite Microwave Remote Sensing
Space related research topics at Department of Radio Science and Engineering

- Space weather
- Ionosphere
- Planetary atmosphere
- Asteroids
- Nanosatellites
- Microwave instruments
- Satellite sensors
- Radio astronomy
- Nanosatellite platforms
- Airborne microwave remote sensing
- Millimeter wave technology
Education: Learning by doing
Aalto-1
The Finnish Student Satellite
LUMA program for gymnasiums
Current small satellite projects at Aalto University

- Aalto-1 CubeSat
- Aalto-2 CubeSat
- ICEYE spin-off project
Aalto-1
The Finnish Student Satellite
Aalto-2
Matkalla avaruuteen

Antti Kestilän, Pekka Laurila ja Rafael Modrzejewski yritys on ensimmäisenä suomalaisena väliaikkaa kaupallisille satelliittimarkkinoille. Arktisia jäählinmaitolaatikkoja tarjoava yritys tähtää satojen miljoonien euronliikevaihdon.

USA:n talous voi yllättää iloisesti

Japani käynnistää varovasti ydinvoimaloitaan

Netflixiä naitetaan Applelle

OMXH +0,72%
Nanosatellites as education platform
Aalto-1
Aalto University
The Finnish Student Satellite
Increasing hands-on teaching
- Open access to results
- Self assessment
- Peer review
- Expert reviews

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### Assessment Application

Applies to Aalto-1 project related work in courses
- S-92.3192 Special Assignment  in Space Technology
- S-92.3200 Student Satellite Project

#### Applicant details

<table>
<thead>
<tr>
<th>Applicant Name</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Period under assessment</td>
<td></td>
</tr>
<tr>
<td>Assessed work topic(s)</td>
<td></td>
</tr>
<tr>
<td>Membership in team and names of other team members</td>
<td></td>
</tr>
</tbody>
</table>

#### Workload

<table>
<thead>
<tr>
<th>Topic</th>
<th>Used hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background Research</td>
<td></td>
</tr>
<tr>
<td>Meetings (incl. conference lectures)</td>
<td></td>
</tr>
<tr>
<td>Software writing</td>
<td></td>
</tr>
<tr>
<td>Hardware building and prototyping</td>
<td></td>
</tr>
<tr>
<td>Testing</td>
<td></td>
</tr>
<tr>
<td>Documentation writing</td>
<td></td>
</tr>
<tr>
<td>Other (what?)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

#### Brief work description

Should contain:
- Conclusions
- Work definition and goal of the work
- Material (is this work based on previous work, book, other thesis etc)
- Methods (how the work is done, inc. software and tools used etc)
Aalto-1
The Finnish Student Satellite
Challenge and opportunities for students

- Industry
- Space Research Community
- Aalto-1 Students
- International CubeSat Community
- Finnish Universities
- Space Technology R&D

- Technology
- Science
- Business
- Teaching

Aalto University
School of Electrical Engineering

Aalto-1
The Finnish Student Satellite
Thermal Aalto-1 The Finnish Student Satellite
Aalto-1
The Finnish Student Satellite
The Finnish Student Satellite
Aalto-1 status
Aalto-

The Finnish Student Satellite
AaSI – Fabry-Perot Spectral Imager
AaSI Spactral Imager EM

EM-model under tests
Motor driver board, ESTCube
The Finnish Student Satellite

Reel motor by DLR

Aalto-1
The Finnish Student Satellite
Aalto Sun sensor PFM
Sun sensor calibration measurements
Aalto-1 UHF Proto
Aalto OBC EM
Aalto Student Satellite
Aalto-1
The Finnish Student Satellite
iADCS EM in test bench
Stack Integration tests
Aalto - The Finnish Student Satellite
Ground Station
OH2AGS

Address: Otakaari 5 A, Espoo, Finland.
60.188732 N and 23.830764 E

Capability:
• VHF
• UHF
• S-band
Aalto-2
and
ICEYE
On board digital signal processing and data handling
Affordable sensors for spacecrafts
Short Skyvan aircraft
Testing and standardisation

- Testing Center for small satellites at Aalto University
- Participation in international activities on nanosatellite testing and standardisation
Future directions

- Nanosatellite instruments and science
  - Microwave remote sensing
  - Radio Frequency Interference
  - Space Weather and Ionosphere
  - Novel concepts

- Spin-off and entrepreneurship
Conclusions

- Space technology education growing in Finland
- Aalto University investing in future space technology
- New Master’s Programme on Nano and Radio Sciences starting 2015

- Aalto-1 is in integration and qualification phase
- Aalto-1 looking for launch in summer 2015
- Aalto-2 is
- ICEYE radar installed to SkyVan aircraft
- Aalto-3 ideas on the table
Thank you!