CUBESATS ACTIVITIES AT THE UNIVERSITY OF LIÈGE

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OUFTI-1

Orbital Utility For Telecommunication Innovation-1
OUFTI-1, Belgium’s first nanosatellite, launched 25 April 2016 on Soyuz Flight VS14 under 1st FYS programme
OUFTI-1 heard all over the world!

> 500 Beacon messages received from HAM operators
OUFTI-2
Orbital Utility For Telecommunication Innovation-2
OUFTI-2 missions

Primary

• **D-STAR**: Provide D-STAR amateur radio communication repeater in space

Secondary

• **RAD**: Test two different types of shields to protect electronics from space ionizing radiations

• **IMU**: Estimate attitude of satellite using inertial & magnetic measurements (conceived & built by high-school students)
What is D-STAR?

• Digital-Smart Technology for Amateur Radio
• Digital communication protocol
• Voice & data transmission
• Radio & internet (roaming)
• Radio transmissions on VHF, UHF, and L bands
• Data: 1200 bps - Voice: 3600 bps (AMBE encoding)
• GMSK modulation
How amateur-radio operators will use OUFTI-2 (1)
How amateur-radio operators will use OUFTI-2 (2)

User A in antenna footprint

Satellite Ext.

Controller

Gateway G

D-STAR Repeater ULg

D-STAR Zone ULg

VHF C

UHF B

Controller

Gateway G

D-STAR Repeater

1.2 GHz A

VHF C

UHF B

Controller

Gateway G

D-STAR Repeater

D-STAR Zone

User B

Internet
Complete OUFTI-2 system: space & ground segments
Space segment
OUFTI-2 CAD model

- VHF antenna (truncated)
- MECH (ant. deployment)
  - Chassis
- UHF antenna (truncated)
- Cover plate
- Solar panels
- Base plate
OUFTI-2: hardware architecture
Let’s take a photo tour of OUFTI-2 CubeSat!
On-board computer (OBC): OBC1 & OBC2
Communication (COMM): AX.25, D-STAR, RF-IN/OUT
Communication (COMM): BCN
Batteries
Structure (STRU) & solar panels
Mechanical systems (MECH): antennas deployment system
First secondary payload: RAD
Ground segment
Ground segment: hardware architecture

Satellite tracking antenna

Control segment

D-STAR terrestrial repeater

Rooftop Control room

D-STAR segment

Polarization switch

Pre-amplifier

Amplifier

Rotor controller

Rotor remote controller

Splitter

Combiner

IC-910H (BCN)

IC-9100 (D-STAR)

IC-910H (AX.25)

IC-910H (D-STAR extension)

BCN computer:
- BCN decoding
- Rotor control/satellite tracking with Orbitron
- Frequency control of IC-910H & IC-9100

AX.25 computer
- AX.25 decoding/encoding through TNC

TNC

VHF C

UHF B

Controller

Gateway G

Internet

D-STAR repeater ULg
Let’s take a photo tour of OUFTI-2 ground segment!
Ground segment: control room
Ground segment: rooftop

Satellite tracking antenna

D-STAR repeater antenna
OUFTI-NEXT

Orbital Utility for Thermal Imaging (TBC)
Mission concept

• Smart irrigation strategy of agricultural fields
  → Possibility to detect lack of water by monitoring the leaf surface temperature

• 69% of water used for agriculture
• 40% of the fields are irrigated
  → high potential applications
Mission specification

Long term goal:
• 50m resolution
• Daily revisit (constellation)
• Mid-wave IR
Preliminary feasibility study

Feasibility study of an in-orbit demonstrator:

- 100m ground resolution
- CubeSat standard
- Fast development (<2 years)
- Collaboration between FSC, CSL and FS.
Payload

- Developed by CSL
- Mid-wave IR telescope
- Time Delayed Integration (TDI) linear scan
Payload

- MWIR cooled detector

<table>
<thead>
<tr>
<th>Neutrino™</th>
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<tbody>
<tr>
<td>Thermal Imager</td>
<td>640 x 512, (15µm pitch) MWIR InSb</td>
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<tr>
<td>FPA / Digital Video Display Format</td>
<td>640 x 512</td>
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<tr>
<td>Analog Video Display Format</td>
<td>640 x 512 (PAL), 640 x 480 NTSC</td>
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<tr>
<td>Spectral Band</td>
<td>3.4 - 5.1µm Standard</td>
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<tr>
<td>Full Frame Rates</td>
<td>30 Hz (NTSC), 25 Hz (PAL)</td>
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<tr>
<td>Sensitivity (NEdT)</td>
<td>&lt;25mK</td>
</tr>
<tr>
<td>Time to Image</td>
<td>&lt;6 min room temp, &lt;10 min at 71°C</td>
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- Three Mirrors Anastigmat by Amos
- Visible camera (TBC)
Platform

- PCB’s
- ADCS
- Payload
- VHF/UHF antenna
- S-Band antenna
Platform

• Body mounted solar panels
Thanks for your keen interest!