5th UNISEC-Global meeting

Space Education Activities and CubeSat Programs in Taiwan

Hsin-Chia (Albert) Lin¹, Jyh-Ching Juang²

¹National Space Organization, Taiwan
²National Cheng Kung University, Taiwan

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Established by Ministry of Science and Technology (MOST) in 1991, National Space Organization (NSPO) has been serving as national space agency and responsible for space technology R&D in Taiwan.

NSPO has 200+ employees and $35M+ USD annual budget funded by MOST (as of 2017). Location: in HsinChu Science Park, Taiwan. https://www.nspo.narl.org.tw/
### NSPO Major Milestones

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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| 1991 | NSPO established  
|      | 1st Phase Program approved |
| 1997 | FORMOSAT-1 Launch  
| 1998 | I&T Facility Completion |
| 1999 | FORMOSAT-3 Launch  
| 2000 | SR-1 Launch  
| 2001 | 2nd Phase Plan approved  
| 2002 | FORMOSAT-2 Launch  
| 2004 | FORMOSAT-3 Launch  
| 2005 | Yamsat Completion  
| 2006 | Approval of FORMOSAT-5 (Updated)  
| 2009 | AIT-TECRO MOA for FORMOSAT-7  
| 2010 | FS-5 Launch  
| 2011 | Approval of FORMOSAT-7  
| 2014 | FS-7 1st Launch  
| 2015 | FORMOSAT-5 I&T Completion  
| 2016 | SR-10 Launch  
| 2017 | 1st Phase  
| 2018 | 1st-2nd Grace Period  
| 2019 | 2nd phase  
| 2020 | 3rd Phase  

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NSPO CubeSats Program

- Taiwan Space Industry Development Initiative- micro-satellite development program
  - Micro/small Satellites Program,
  - CubeSats Program,
  - Sounding Rocket Program,
  - Space Industry Planning and Promotion Program.

- The time span for this CubeSats project is from 2017 to 2022 to launch at least 5 CubeSats.

- Three CubeSat contracts, called IDEASSat, NutSat, and YUSAT, have been issued to Taiwan’s universities and domestic companies in April 2017.
NSPO CubeSat Programs (cont.)

- **CubeSat Mission:**

<table>
<thead>
<tr>
<th>Type</th>
<th>CubeSat Name</th>
<th>Contractor</th>
<th>Contract Start</th>
<th>CubeSat Delivery to NSPO</th>
<th>CubeSat Mission</th>
</tr>
</thead>
<tbody>
<tr>
<td>3U</td>
<td>IDEASSat</td>
<td>NCU</td>
<td>2017/4</td>
<td>2019/12</td>
<td>ionospheric science</td>
</tr>
<tr>
<td>2U</td>
<td>NutSat</td>
<td>NFU</td>
<td>2017/4</td>
<td>2019/12</td>
<td>ADS-B airplane tracking</td>
</tr>
<tr>
<td>1.5U</td>
<td>YUSAT</td>
<td>MoGaMe</td>
<td>2017/4</td>
<td>2019/2</td>
<td>AIS/APRS tracking systems for marine and land moving objects</td>
</tr>
</tbody>
</table>

- ADS-B: Automatic Dependent Surveillance- Broadcast
- AIS: Automatic Identification System
- APRS: Automatic Packet Reporting System

- **Orbit preferred:** orbit shape, altitude, inclination angle
  - IDEASSat: circular, 450~600km, sun sync
  - NutSat: circular, 450~600km, 30~50 deg, or sun sync
  - YUSAT: circular, 450~600km, 30~50 deg, or sun sync
NSPO CubeSat Programs (cont.)

- IDEASSat:
  - There are 5 professors and about 14 students of Graduate Institute of Space Science of National Central University (NCU) involved in the project.

- NutSat:
  - It is the first CubeSat developed by National Formosa University (NFU), with 5 professors and about 5 students of Aeronautical Engineering Department involved.

- YUSAT:
  - There are two domestic companies, MoGaMe and LETSCOM, and one professor and students of National Ocean University involved.
Taiwan CubeSat Mission Competition

- There are 8 groups submitting the papers. The competition will be held with AASRC conference at Feng Chia University on Dec 9th, 2017.

- Paper List:

<table>
<thead>
<tr>
<th>No.</th>
<th>Paper Title</th>
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<tbody>
<tr>
<td>1</td>
<td>Scintillation and Ionosphere Network (SCION) - A Proposed CubeSat Constellation for Space Weather Monitoring</td>
</tr>
<tr>
<td>2</td>
<td>SDR LTE As IoT Cubic Satellites Communication</td>
</tr>
<tr>
<td>3</td>
<td>An Automatic Self-Assembling CubeSat System</td>
</tr>
<tr>
<td>4</td>
<td>Laser Communication Experiment CubeSat (LACE)</td>
</tr>
<tr>
<td>5</td>
<td>Preliminary Study of Imaging the Exterior of Large Satellites by a CubeSat</td>
</tr>
<tr>
<td>6</td>
<td>Lunar Ionosphere Investigation by Firmament Star CubeSat</td>
</tr>
<tr>
<td>7</td>
<td>ICSat : The CubeSat to Test Integrated Circuit or Industrial Computers</td>
</tr>
<tr>
<td>8</td>
<td>INSPIRESat-1 Communication Subsystem and Engineering</td>
</tr>
</tbody>
</table>
Space Education

- One **space science summer campaign for senior high school students** was held by NCU with NSPO support budget this year. There are about **60** students learning how to develop satellite science instruments by hands. Some of them form a group to join the CubeSat Mission Competition.

- Meanwhile, there are a series of **satellite introduction classes** have been held by NSPO, including satellite systems engineering, ADCS, flight software, communication and power. The attendee count has accumulated to more than 120.
Public Space Education via Radio

- To introduce space and satellite knowledge to the public, NSPO cooperates with the student internet radio station of National Chiao Tung University, “goto&Play”, to make a radio show, “Interstellar School”.
- The shows contents include space people talk, space news, space knowledge, and space arts.
**NCKU PHOENIX CubeSat**

- NCKU has launched a 2U CubeSat named as PHOENIX as a part of the QB50 program.
- QB50 program:
  - under the support of the European Union’s Seventh Framework Programme for Research and Technical Development
  - led by the von Karman Institute (VKI)
  - aim to multi-point measurements of the upper layers of the atmosphere, the mid-lower thermosphere, located between 200km and 400 km altitude, through a constellation of CubeSats.
- The PHOENIX was released from the International Space Station on **May 17, 2017** and had been successfully functional ever since.
NCKU SPACE Event

- Based on the success, NCKU has organized a NCKU SPACE event on Nov 8 and 9, 2017 to seek for further international collaboration and discuss potential for space education and business.

- The event was well attended and renowned scholars have made presentations to share their observations and research results.
Future Works

- Besides, these CubeSat projects mentioned above, NSPO will initiate more CubeSat projects in the following years. Meanwhile, NSPO will assist domestic CubeSat products to pass the space qualification validation and enter international market.

- There are some difficulties to develop microsats and CubeSats in Taiwan: less budget supported by government, limited professors and students involved in the Space area, and low economic attraction for domestic companies, and so on.

- There should be more launch activities, including sounding rockets, in Taiwan to encourage people to join the space research and satellite development.

- We hope to join the CubeSat constellation program and get more CubeSat development experiences and launch chances via international cooperation.