APSCO Training Course and ISSI-BJ & APSCO Joint Forum on

Science Missions using CubeSats

June 3-8, 2019

Si Racha, Chon Buri Province, Thailand

HANDBOOK

CONTENTS

Editor/Graphic Design: Anna YANG, ISSI-BJ

WELCOME

Dear Participants,

You are warmly welcomed to attend the APSCO Training Course and Joint ISSI-BJ & APSCO Forum on"Science Missions using CubeSats"

The Asia-Pacific Space Cooperation Organization (APSCO) is going to organize a training course followed up by two-day of brainstorming Forum on "Science Missions using CubeSats" focusing for space development countries. The training course is organized for three days by APSCO and then a two-day brainstorming Forum is jointly organized by International Space Science Institute in Beijing (ISSI-BJ). Both events share the same theme and topics. The training delivery mode will be as lectures followed by Forum (Please find the tentative schedule in part VIII).

Besides the training course and forum, we will provide you cultural visit to make your stay in Si Racha more enjoyable.

It's our great pleasure to provide satisfactory services for your study and stay during the training course and forum. Any suggestions and/or feedback will help us to make our future trainings more successful.

APSCO Secretariat

ORGANIZERS

ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

The Asia-Pacific Space Cooperation Organization (APSCO) was officially inaugurated in 2008, as an inter-governmental Organization for multilateral cooperation in Space Science, Space Technology and Space Application, with its 8 Member States: Bangladesh, China, Iran, Mongolia, Pakistan, Peru, Thailand and Turkey. Indonesia is APSCO's Signature State and Mexico as Observer. Egypt was accepted as Associate Member in 2016.

APSCO executes activities in a variety of fields defined in the APSCO Convention to facilitate space capacity building of developing Countries.

APSCO cultivates talents in the Member States through its Degree Education Program, Student Small Satellite Program and Knowledge-Sharing Platform. Capability is built through resource sharing, joint research projects and pooling up of technical expertise.

At the International fora, APSCO is a Permanent Observer at the United Nations Committee on the Peaceful Uses of Outer Space(UNCOPUOS) and organizes high-level International events in collaboration with United Nations Office for Outer Space affairs (UNOOSA) and other space-related organizations and institutions.

INTERNATIONAL SPACE SCIENCE INSTITUTE - BEIJING

The International Space Science Institute in Beijing (ISSI-BJ) was jointly established by the National Space Science Center (NSSC) and the International Space Science Institute (ISSI) with the support of the Chinese Academy of Sciences (CAS). ISSI-BJ is a close cooperation partner of ISSI in Bern. The two institutes share the same Science Committee, study tools, and other information of mutual relevance, but use different operational methods and funding sources.

ISSI-BJ is a non-profit research institute. Our main mission is to contribute to the achievement of a deeper scientific and technological understanding of future space missions as well as of the scientific results from current and past missions through multidisciplinary research, possibly involving, whenever felt appropriate, ground based observations, modelling, numerical simulation and laboratory experiments, using the same tools as ISSI, i.e. Forums, International Teams, Workshops, Working Groups or individual Visiting Scientists.

The Program of ISSI-BJ covers a widespread spectrum of space science disciplines, including astrophysics, solar and space physics, planetary science, astrobiology, microgravity science and Earth observation from space.

GEO-INFORMATICS AND SPACE TECHNOLOGY DEVELOPMENT AGENCY

Geo-Informatics and Space Technology Development Agency (GISTDA) is a government organization under the supervision of the Ministry of Science and Technology. It is Thailand's core agency responsible for providing satellite remote sensing and Geographic Information System (GIS) data and services to both public and private sectors, nationally and internationally. GISTDA also conducts capacity building programs in GIS and its applications and actively involves in research and development in both GIS and space technology.

SPONSORS

Chinese Academy of Sciences (CAS)

National Space Science Center (NSSC)

OUTLINE AND PROGRAM

CONTEXT

CubeSats have enjoyed widespread acceptance in the space community since their inception, with a growing developer list. CubeSat can help reduce the costs of technical developments and scientific investigations. This lowered barrier to entry has greatly increased access to space, leading to an exponential growth in the popularity of CubeSats also in space development countries. Although barriers to entry are very low but the return on education, experience, and collaborative relationships gained can be invaluable. Small satellites have been launched with considerable success by many organizations in developed and developing countries. Over 800 CubeSats have been launched as of April 2018. Some CubeSats became the first national satellites of their countries. Producing their own satellites was considered a national achievement and a source of national pride by each country. Coupled with realistic and focused goals such satellites make it possible for a country with even a small research budget and little or no experience with space technology to participate in their development, launching and operation. Small satellites thus present an ideal opportunity for training students, engineers and scientists in different disciplines, including engineering, software development for on-board and ground computers and management of sophisticated technical programs.

OBJECTIVES OF THE TRAINING COURSE

The training aims to provide an overview of the importance, current practice and future perspectives for “Science Missions using CubeSats”. and the different generic categories of instruments used to monitor space weather from the ground.
The School will also facilitate and initiate different discussions in an international and multi-disciplinary way; it will encourage creativity and provide the contacts for the participants to develop a professional network. International collaboration will also be an important theme at the school.

OBJECTIVES OF THE FORUM

The forum section brings the trainees to a larger community of scientists, scholars and futuristic minds and gives them the opportunity to hear the new ideas, get more push towards a carrier in this field and also give wings to their own thoughts and ideas as well.

TIME AND PLACE

Date: 3-8 June, 2019

Venue: Geo-informatics and Space Technology Development Agency (GISTDA) , in Si Racha, Chon Buri Province, Thailand
Auditorium and Training room at Geo-informatics Research & Training Center building at SKP

WORKING LANGUAGE

English is the official language of the training course and forum.

TRAINING COURSE PROGRAM

Monday, June 3

	Subject	Contributor
09:00 – 9:30	*Opening and Group Photo*	
	Cubesats: Basics and Engineering Introductory course for the historical, architectural and engineering overview	
9:30 – 10:20	Introduction to CubeSat technology, current trends and subsystem overview	Rizwan Mughal
10:20 – 10:40	*Coffee Break*	
10:40 – 12:30	Orbital Mechanics and Space Environment	Qamar Ul Islam
12:30 – 14:30	*Lunch*	
	Cubesats for education: University CubeSats and the role of CubeSats in education	
14:30 – 15:50	Ten years of teaching experience on nanosatellites in Politecnico di Torino	Leonardo Reyneri
15:50 – 16:10	*Coffee Break*	
16:10 – 17:30	Modular design approach for CubeSats, introduction to Aalto-1 and Foresail Cubesats	Rizwan Mughal

Tuesday, June 4

	Subject	Contributor
	Cubesats for technology demonstration: Miniaturization of subsystems/sensors and devices	
09:00 – 10:50	Smart structures: embedding mechanical, electronics and energy storage	Leonardo Reyneri
10:50 – 11:10	*Coffee Break*	
11:10 – 12:00	Satellite Propulsion Systems: Design and Development of Pulsed Micro Plasma Thruster	Qamar Ul Islam

Tuesday, June 4

	Subject	Contributor
12:00 – 14:30	*Lunch and Technical visit: Satellite Ground Control and Image Segment of GISTDA*	
	Cubesats for earth observation: Earth observation missions and technologies on-board CubeSats and the new constellation ideas	
14:30 – 15:00	Earth observation missions with CubeSats and small satellites: An overview	Rizwan Mughal
15:00 – 15:20	*Coffee Break*	
15:20 – 16:40	Design optimization of telescopes and imagers for earth observation inside	Leonardo Reyneri
16:40 – 17:30	Link budget design and payload requirement	Qamar Ul Islam

Wednesday, June 5

	Subject	Contributor
	Cubesats: Design and technology conditions A quick look at CubeSats design and new technology development	
09:00 – 10:20	The development of CubeSate technology	Yu Xiaozhou
10:20 – 10:40	*Coffee Break*	
10:40 – 12:00	How to design a CubeSate	Yu Xiaozhou
12:00 – 14:30	*Lunch*	
	Cubesats for Science missions Cubesats for exploration of other planets	
14:30 – 15:50	CubeSat deep space exploration - targets and missions	Martin Langer
15:50 – 16:10	*Coffee Break*	
16:10 – 17:30	CubeSat deep space exploration – design considerations	Martin Langer

FORUM PROGRAM

Thursday, June 6

	Subject	Contributor
	Session 1 Introduction	
09:00 – 9:15	*Registration*	
9:15 – 9:30	Welcome and introduction to ISSI-BJ, APSCO, and to the Forum	Maurizio Falanga Ebrahimi Seyedabadi Pierre Hagmann
9:30 – 10:00	Historical introduction to CubeSats	Qamarul Islam
10:00-10:30	COSPAR Roadmap on Small Satellites for Space Science	Maurizio Falanga
10:30 – 11:00	*Coffee Break*	
11:00 – 11:30	APSCO's current and future plans to use Cubesats as a tool for capacity-building and university cooperation	Ebrahimi Seyedabadi
11:20 – 12:00	Discussion	All
12:00 – 13:30	*Group Photo and Lunch*	
	Session 2 CubeSats for Space Sciences	
13:30 – 14:00	Using CubeSats for Science Missions seen from a physics point of view. What can we do and when?	René Fléron
14:00 – 14:30	Advantages and disadvantages of CubeSat science missions compared to larger missions	Tino Schmiel
14:30 – 15:00	Cubesat, a new platform for deep space research	Xiaozhou YU
15:00 – 15:30	*Coffee Break*	

Thursday, June 6

	Subject	Contributor
15:30 – 16:00	High Energy Rapid Modular Ensemble of Satellites (HERMES): probing space-time quantum foam and hunting for gravitational wave electromagnetic counterparts	Luciano Burderi
16:00 – 16:30	CubeSat for High Energy particle measurements	Muriel Richard
16:30 – 17:30	Students Presentations	
17:30 – 18:00	Discussion	All
19:00	*Social Dinner*	

Friday, June 7

	Subject	Contributor
	Session 3 Cubesats Technology issues for science	
9:00-09:30	CubeSat Technology Capabilities	Leonardo Reyneri
9:30-10:00	Architectural and Engineering Overview of University-built CubeSats	Martin Langer
10:00-10:30	CubeSats Moon Exploration with the Japanese EQUULEUS and OMOTENASHI	Nicola Baresi
10:30-11:00	*Coffee Break*	
11:00-11:30	Foresail satellites for space science by Finnish Centre of Excellence in Sustainable Space. GTO orbit, radiation tolerant design, deorbiting systems	Jaan Praks
11:30-12:00	Engineering overview of Foresail CubeSats	Muhammad Rizwan Mughal
12:00-13:30	*Lunch*	
13:30-14:00	Bio science Experiments with Cubesats	Qamarul Islam

14:00-14:30	Small scale magNetospheric and Ionospheric Plasma Experiment	Jaeheung Park
14:30-15:00	Science Missions and CubeSat Activity in Thailand	Amarin Pimnoo Shariff Manuthasna
15:00-15:30	*Coffee Break*	
15:30-16:30	Students Presentations	
16:30-17:00	Discussion	All
	Session 4 Synergies and Collaboration	
17:00-17:30	Discussion Future work plan: - Outline, structure, publication of the forum report - Action items - Summary of the Forum	

Saturday, June 8

Technical/Cultural Visit	

PRACTICAL INFORMATION

VENUE

The school will take place at **Sirindhorn Center for Geo-Informatics** (SCGI) located in Space Krenovation Park (SKP) - โครงการอุทยานรังสรรค์นวัตกรรมอวกาศ, Si Racha district, Chon Buri province, Thailand.

Space Krenovation Park (SKP) consists of 6 main parts:

1. Sirindhorn Center for Geo-Informatics: SCGI
2. Thaichote Operations Center
3. Space Technology Laboratory Center
4. Space Technology Park Building
5. GIS & Space Technology Museum
6. Residential Zone (The Vertical View)

SIRINDHORN CENTER FOR GEO-INFORMATICS

- Total area 3,892 sq.m.
- 1 Auditorium (180 seats)
- 1 Lecture Room
- 1 Laboratory (80 seats), may be divided into 2 (40 seats per each)
- 3 Small Conference Rooms / Lecture Rooms (15, 15, 45 seats)
- 1 Research Room (35 seats)
- 1 Cafeteria

Auditorium

Laboratory

Conference Room

Museum (Space Inspirium)

ACCOMMODATION

Cholchan Pattaya Resort

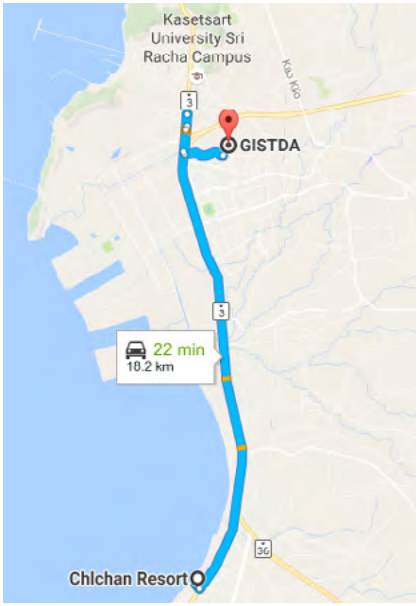
The hotel is located outside of the SKP, about 20 min by car.

19 Moo 1, Tambon Nagluea, Amphur Banglamung Pattaya, Chonburi
Email:
cholchan@pattayaresort.com

Telephone:
+66 (0) 38 702 777
Mobile:
+66 (0) 83 888 1515

For taxi:

กรุณาไปส่งข้าพเจ้า ที่โรงแรม ชลจันทร์ พัทยา รีสอร์ท
ลขที่ 19 หมู่ 1 ตำบล นาเกลือ อำเภอ บางละมุง พัทยา ชลบุรี



The organizers cover only the room expense (breakfast included) for the sponsored participants. Any extra charges, such as telephone, laundry, mini bar etc. will be borne by the participants themselves.

Note: Room rate is USD 63 /night (one bed room & one breakfast). Please check out before 14:00, a half-day price will be charged afterwards; and a full-day price will be charged after 18:00.

TRANSPORTATION

Transportation between the Bangkok Suvarnabhumi International Airport and Cholchan Pattaya Resort will be provided for all participants on their arrival and departure. A driver will pick up the participants at the Arrival Gate with a placard with our logos.

LUNCH & DINNER

Lunch will be provided at the Cosmo Cafeto in Space Krenovation Park (SKP). Dinner will be arranged at "San Sam Ran Restaurant" which is a seafood resaurant 300 meters from the hotel. Meal coupons will be provided, please keep them carefully

USEFUL INFORMATION

Credit Cards: Major credit cards such as Visa, Mastercard, JCB and American Express, are readily accepted at most hotels, airlines, restaurants and upscale merchants.

Currency: USD 1.00 = 31.57 THB (approximately)

Electricity: 220 volts AC

Time: UTC/GMT +7 hours

Weather: According to the weather forecast, from 3 to 8 June, the weather in Si Racha turns from sunny to cloudy, the temperature is between 25℃ to 33℃.

CONTACT PERSONS

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LECTURERS AND LECTURES

LECTURERS AND LECTURES

Qamar ul Islam

Insitute of Space Technology (IST), Pakistan

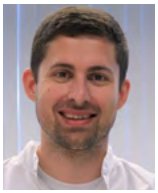
Dr. Qamar ul Islam is the Head of Space Science Department, Director of Space Systems Lab, Project Director of IST Cubesat "ICUBE" Satellite Program and IST lead for PNSS1 micro satellite project. He is the Chief Editor of theJournal of Space Technology, HEC Recognized Journal. Dr Islam is the IST lead for Asia Pacific Space Cooperation Organization (APSCO) SSS Satellite project. He is a Member of the Faculty Board of Studies (FBS), Member of the Academic Council and Member of the Syndicate. He is also an Evaluator of Engineering Programs for Accreditation by Pakistan Engineering Council (PEC).

Lectures titles:

Orbital Mechanics and Space Environment
Satellite Propulsion Systems: Design and Development of Pulsed Micro Plasma Thruster
Link budget design and payload requirement

Martin Langer

Technische Universität München, Germany



Martin Langer received his Dipl.-Ing. and Dr.-Ing. Degree in Aerospace Engineering from the Technical University of Munich (TUM). He was the project manager of MOVE-II, a single unit CubeSat, launched in December 2018 and currently leads the Small Satellite research group at the Institute of Astronautics of TUM. His research interests cover reliability assurance and risk mitigation of Small Satellites, development of robust SmallSat Hard- and Software for space use and hands-on space education in

universities. Martin authored and co-authored more than 40 scientific papers and supervised more than 60 Master's & Bachelor's Theses in the field of astronautics.

Lectures titles:

CubeSat deep space exploration - targets and missions
CubeSat deep space exploration – design considerations

Muhammad Rizwan Mughal

Institute of Space Technology (IST), Pakistan; Aalto University, Finland

Dr. Muhammad Rizwan Mughal completed his PhD in Electronics and Communication Engineering from Politecnico di Torino, Torino, Italy in March 2014. Since June 2014, he has been an Assistant Professor with the department of Electrical Engineering, Institute of Space Technology (IST), Islamabad, Pakistan. He is subsystem leader in APSCO student small satellites, Pakistan National Student Satellite (PNSS) and iCube projects. He is also a principal investigator (PI) of research project to design modular and plug & play satellites.Since July 2018, he has also been associated with department of Electronics and Nano-engineering, Aalto University, Espoo, Finland as a postdoctoral research fellow. In this role, he is team member and subsystem advisor in Foresail-1 and Foresail-2 CubeSats and involved in a European Space Agency (ESA) sponsored project to access the capability of small satellite platforms for earth observation and remote sensing applications. His main interests include plug-and-play design of low-cost small satellites, smart communication solutions for small satellites, wireless solutions for intra-satellite data communication, and testing methodologies for small satellites.

Lecture title:

Introduction to CubeSat technology, current trends and subsystem overview
Modular design approach for CubeSats, introduction to Aalto-1 and Foresail Cubesats
Earth observation missions with CubeSats and small satellites: An overview

Leonardo Reyneri

Politecnico di Torino, Italy

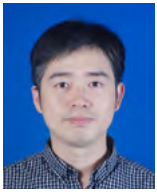
Professor of Electronics at the Polytechnic of Turin, he received M.Sc. cum laude at the Polytechnic of Turin in 1984 and the Ph.D. in 1992. Prof. Reyneri is currently active in the design of low-cost space systems and modular micro and mini satellites for surveillance and environmental monitoring. He is responsible for a group that brings together academic and industrial partners, with the aim of developing innovative techniques and circuits for low cost modular space systems.Prof. Reyneri is one of the developers of ARAMIS architecture, which led to the development of innovative technologies, circuit techniques, SW approaches and test methods for low-cost micro and mini-satellites. Some demos of these innovative technologies will soon be launched in orbit and other demos will fly to the International Space Station (ISS). Prof. Reyneri has published over 240 articles and holds 8 patents. He has also been a guest editor and referee of international journals and conferences and has worked on program committees or international conference management. He also spent some periods at the European Space Agency (3 years) and at the University of Pisa (3 years), Edinburgh and Granada. He has been the coordinator of several national research programs, two European projects, together with two major regional projects for the development of innovative ideas. He is currently cooperating with MIT in Boston (USA), and several European universities in the field of nano and microsatellites.

Lectures titles:

Ten years of teaching experience on nanosatellites in Politecnico di Torino
Smart structures: embedding mechanical, electronics and energy storage
Design optimization of telescopes and imagers for earth observation inside CubeSats

Yu Xiaozhou

Shaanxi Engineering Laboratory for Microsatellites, China



Dr. Yu Xiaozhou received his bachelor's degree from Northwestern Polytechnical University (NPU) in 2001. He worked as a lecturer in the school of astronautics in NPU after he got his doctor degree in 2006. In 2009, he became an associate professor and the vice director of Shaanxi Engineering Laboratory for Microsatellites (Provincial key laboratory). In 2017, he became the vice director of National United Engineering Laboratory of Microsatellite Technology and Application (National key laboratory). Dr. Yu Xiaozhou has been the project investigator in nearly twenty space projects, including the National High-tech R&D Program (863 project) and Astronautical Supporting Technology Foundation, etc. He is the project investigator of a 2U CubeSat Aoxiang-1 (launched in 2017) and the project manager of 12U CubeSat Star of AoXiang (launched in 2016). In the QB50 international CubeSats project funded by EU FP7, NPU is the Asia coordinator, and he is the key person and consortium board member. For his contribution to space research, he received several awards, including the Young Space Leader Award from International Astronautic Federation in 2015 and Gold Medal of the Innovation and Entrepreneurship Competition of the 18th China Association for Science and Technology Workers Annual Meeting in 2016. He is one of the main organizers in several national level student spacecraft competitions. As a professor in NPU, he has made a contribution to education. As a result, he received several teaching awards, including the Second Prize of Teaching Achievement Award from Ministry of Education of the People's Republic of China second special prize of teaching achievement award from Shaanxi province in 2015. First prize of teaching achievement awards in 2013 and 2015 from Northwestern Polytechnical University. Dr. Yu Xiaozhou is also active in international space research and cooperation. Now he is the Vice Chairman of the Space University Administrative Committee of International Astronautical Federation IAF and Member of AIAA Small Satellite Technical Committee

Lectures titles:

The development of CubeSat technology
How to design a CubeSat

PARTICIPANTS

	First Name	Last name	Affiliation
1	Azam	Muhammed	Bangladesh Space Research and Remote Sensing Organization (SPARRSO), BANGLADESH
2	Baatar	Uugantsetseg	Secretariat of the State Great Hural of Mongolia, MONGOLIA
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4	Boonsup	Taweeporn	GISTDA, THAILAND
5	Burderi	Luciano	University of Cagliary, ITALY
6	Dag	Enes	TÜBİTAK UZAY Space Tech. Res. Inst., TURKEY
7	En	Lijuan	ISSI-BJ, CHINA
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19	Martin	Langer	Technische Univ. München, Germany, GERMANY
20	Mina	Bayat	Iranian Space Agency, IRAN
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	First Name	Last name	Affiliation
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24	Park	Jaeheung	Korea Astronomy and Space Science Institute, KOREA
25	Pimnoo	Ammarin	GISTDA, THAILAND
26	Praks	Jaan	Aalto University, FINLAND
27	Prasit	Apirat	National Astronomical Research Institute of Thailand, THAILAND
28	Reyneri	Leonardo	Polytechnical of Torino, ITALY
29	Richard	Muriel	Swiss Federal Institute of Technology Lausanne (EPFL), SWITZERLAND
30	Saensuriwong	Suriyaphon	GISTDA, THAILAND
31	Seyedabadi	Mohammad Ebrahimi	Asia-Pacific Space Cooperation Organization (APSCO), CHINA
32	Sihirunwong	Sutinee	GISTDA, THAILAND
33	Sisman	Tahsin Çagrı	University of Turkish Aeronautical Association, TURKEY
34	Some	Jagobandhu	Bangladesh Space Research and Remote Sensing Organization, BANGLADESH
35	Suepa	Tanita	GISTDA, THAILAND
36	Tanveer	Fahad	SUPARCO, PAKISTAN
37	Torteeka	Peerapong	National Astronomical Research Institute of Thailand, THAILAND
38	Ulambayar	Tuguldur	National University of Mongolia, MONGOLIA
39	Vongsantivanich	Wasanchai	GISTDA, THAILAND
40	Weng	Ting	Asia-Pacific Space Cooperation Organization (APSCO), CHINA
41	Yu	Xiaozhou	Northwestern Polytechnical University, CHINA
42	ZHANG	Rusheng	China National Space Administration, CHINA

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