





# International GNSS Summer School in Tokyo since 2013

MULTI GNSS ASIA

- Period : 6 days in Summer
- Venue : Tokyo University of Marine Science and Technology (TUMSAT)
  - Organized by Faculty of Marine Technology, TUMSAT
- Co-organized by Institute of Positioning, Navigation and Timing of Japan (IPNTJ)
- Sponsored by Japan Science and Technology Agency (JST)



Supported by JRC https://www.jrc.co.jp/jp/index.html
 MGA http://www.multignss.asia/
 Septentrio https://www.septentrio.com/en
 QSS http://www.qzs.jp/
 u-blox https://www.u-blox.com/ja

Laboratory of Satellite Navigation Engineering

Japan Asia Group

KUSAI KOGYO CO., LTD.



# **Outline of International Summer School**

- Date : 2019/07/29-08/03: 6 days
- Organized by : Tokyo University of Maine Science and Technology (TUMSAT), Japan
- Co-Organized by : The Institute of Positioning, Navigation and Timing of Japan
- Attendees : Japanese and foreign students of post graduate level & young engineers and instructors who are teaching GNSS in their own countries.
- Number of participants : 40
- Language : English
- Fee : 60,000JPY, (20,000JPY for students).
- Supported by : MGA(Multi-GNSS Asia), QZSS Services
- Sponsored by Japan Science and Technology Agency (JST)

# Scholarship Applicants 2019

Countires	Mo.	Countires	Mo.	Countires	Mo.
Australia	1	Iran	3	Singapore	1
Canada	2	Malaysia	3(1)	Sri Lanka	21 (3)
Cambodia	1	Mongolia	19 (3)	Taiwan	1
China	6 (1)	Myanmar	1 (1)	Thailand	2 (1)
Egypt	1	Nepal	7(1)	Turkey	2
India	11 (3)	Pakistan	18 (2)	Viet Nam	2(1)
Indonesia	4 (1)	Philippines	7 (2)		
Т	otal 11	0 151	Suppor	ting Count	ries
-			Suppor		
		(#)	:JST Sch	nolarship A	warded #
125					



Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, Fiji, India, Indonesia, Kazakhstan, Korea, Kyrgyz Republic, Lao, Malaysia, Maldives, Marshall Islands, Micronesia, Mongolia, Myanmar, Nepal, Pakistan, Palau, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Islands, Sri Lanka, Taiwan, Tajikistan, Thailand, Timor-Leste, Tonga, Turkmenistan, Uzbekistan, and Viet Nam

We can invite students from the other countries by our own budget.

# **IPNTJ** Participants in 2013-2019



Country	13	14	15	16	17	18	19	Country	13	14	15	16	17	18	19
Pakistan	0	5	2	3	2	1	1	Brunei				1	2	0	0
Taiwan	6	3	5	4	6	4	0	Malaysia	0	1	1	1	2	0	1
Thailand	4	2	2	3	4	1	2	Myanmar					1	1	1
Philippines	2	2	2	4	2	2	2	India			1	1	1	1	3
Nepal	1	0	0	1	1	1	1	Mozambique					1	1	0
Mongol	0	2	1	1	1	1	3	Singapore					1	1	1
China	0	3	2	1	1	7	1	Nigeria				1			0
Indonesia	2	2	2	4	2	2	2	Korea						1	0
Sri Lanka	1	0	1	1	1	2	3	Turkey						1	0
Viet Nam							1	Japan	20	17	15	14	16	12	17*
Cambodia							1	Total	40	39	39	41	44	39	40



#### 2019 Participants

22 of them are invited, selected from over 100 applicants for the scholarship.

\*Include one foreign student studying in Japan.

# **IPNTJ** Group Photo, August 1<sup>st</sup>, 2018





Time Table in 2019



MULTI GNSS ASIA

/////10.								
Tentat	ive Time Table	e 2019						
	29-Jul	30-Jul	31-Jul	1-Aug	2-Aug	3-Aug		
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday		
0830-1000	Introduction	Class B-1	Class C-1	Class B-5	Practice for System	GNSS Signal Security****		
1000-1010	Break	Break	Break	Break	Design, followed by	Break		
1010-1140	Class A-1	Class B-2	Class C-2	Class B-6	SD-workshop	GNSS Authentification****		
1140-1230	Lunch	Lunch	Lunch	Lunch	Lunch 1200-1240	Lunch		
1220 1400	Class A 2	Close P. 2	Class C 2	DTK LID Dractice	Port Cruise G-I	GNSS Raw Measurements		
1250-1400	Class A-2	Cldss D-5	Class C-5	KTK-LID Plactice	Marime Museum G-I	from Android Device****		
1400-1410	Break	Break	Break	Break		Break		
1410-1540	Class A-3	Class B-4	Special Lec. **	Class C-4 SDR I	Port Cruise G-II Marime Museum G-I	Pariticipants Workshop		
1540-1550	Break	Break	Break	Break		Break		
1550-1720	Class A-4	QZSS-Intro & Demo*	Septentrio Seminar***	Class C-5 SDR II	ALLYSTAR Seminar*****	Pariticipants Workshop Closing		
1730-	Welcome Party	1 class=9	0 minutes		Farewell party			
	Instructors	Introduction	Dr. Akio Yasuda		System Design by	****hy Dr. Dinoch		
		Class-A	Dr. N. Kubo & Dr	.Feng-Yu Chu A-1,2	Dr. Nashika Kabtaka	Manandhar		
		Fundamentals	Dr. Ivan G. Petro	vski A-3,4	Dr. Naoniko Kontake	Wallaliullai		
		Class-B	Dr. Takeyasu Sak	(ai , B-1,2,3,4	* by QZSS G	roup		
🚽 🦻 🦻 Septentrio		Software	Mr. Tomoji Taka	su B-5,6,Practice	**Status of GIONET, CORS in Japan by H. Matsumur			
		Class-C	Dr. Toshiaki Tsuji	i, C1,2,3	***GNSS Receiver Practice by Jan De Turck			
FU		Receiver	Dr. Taro Suzuki,	C4, SDR-Practice	*****by Justin Yang			

# IPNTJ

# Introduction to GNSS (Day 1)

- Introduction (by Dr. A. Yasuda)
- 1. Outline of the summer school
- A-1, 2 Basic of GNSS (by Dr. N. Kubo and Feng-Yu Chu)
- Coordinates Systems / GNSS Time systems / Satellite Position Measurements Errors / Basic Theory of GNSS Positioning
- GNSS Precise Positioning
- A-3.4 GNSS overview and GNSS RF and DIF LAB (by Dr. Ivan Petrovski)
- 1. Positioning with GNSS and Satellite Orbits
- 2. GNSS signals
- 3. GNSS receiver
- 4. GNSS Lab: ARAMIS Rx (free academic version)
- 5. GNSS error budget GNSS Lab: DIF & RF Simulator (free academic version)
- 6. GNSS Lab. Case study: DIF Simulator + MATLAB (free software)
- 7. Case study: off-the-shelf receiver RAIM



## Lunch Time



## Lunch Menu (Sample)





#### Photo @ Welcome Party 2019





# Positioning Algorithm (Day 2)

B-1,2,3,4. GNSS Positioning Program (by Dr. T. Sakai)

- Positioning Algorithm by Pseudo-Ranges
- Processing of RINEX files
- Various Considerations for Improved Results
- Differential GPS

Bring your laptop with C compiler installed.

Special Lecture : CLAS by 'Michibiki' (QZSS) (by Dr. Rui Hirokawa, Mitsubishi Electrics)



# GNSS Signal and Receiver (Day 3)

- C-1,2 Introduction into GNSS signals. (by Dr. T. Tsujii)
  - 1. Spread-spectrum concept and benefits for GNSS.
  - 2. GNSS frequencies and their specifics with regard to radio signal propagation.
  - 3. Code and carrier generation in GNSS transmitters and simulators.
  - 4. GNSS navigation messages.
- C-3 Receiver design and INS integration.
- 1. Main components and their functions. (Antenna / RF front end / baseband processor / navigation processor.)
- 2. Baseband processor in detail.(Operation of baseband processor: Acquisition / Operation of baseband processor: Code and carrier tracking loops / Reading navigation message.)

# Positioning Algorithm and RTKLIB (Day 4)

#### **B-5,6**

GNSS precise positioning and RTKLIB (by Mr. T. Takasu)

- Carrier-phase-based positioning with GNSS
- Theory of RTK and PPP
- RTKLIB Practice
  - RTK and PPP practice with RTKLIB



C-4 Introduction of Software Defined Receiver (by Dr. T. Suzuki) GNSS-SDRLIB: Introduction of an open source software GNSS receiver



# GNSS Signal and Receiver (Day 3)

C-1,2 Introduction into GNSS signals. (by Dr. T. Tsujii)

- 1. Spread-spectrum concept and benefits for GNSS.
- 2. GNSS frequencies and their specifics with regard to radio signal propagation.
- 3. Code and carrier generation in GNSS transmitters and simulators.
- 4. GNSS navigation messages.
- C-3 Receiver design and INS integration.
- 1. Main components and their functions. (Antenna / RF front end / baseband processor / navigation processor.)
- 2. Baseband processor in detail.(Operation of baseband processor: Acquisition / Operation of baseband processor: Code and carrier tracking loops / Reading navigation message.)

**Special lecture**: Status of GIONET, CORS in Japan by H. Muramatsu (Geospatial Information Authority of Japan)

# Positioning Algorithm and RTKLIB (Day 4)

**B-5**,6

GNSS precise positioning and RTKLIB (by Mr. T. Takasu)

- Carrier-phase-based positioning with GNSS
- Theory of RTK and PPP
- RTKLIB Practice
  - RTK and PPP practice with RTKLIB
- C-4,5 Introduction of Software Defined Receiver (by Dr. T. Suzuki)
- Signal structure of GPS, GLONASS, Galileo, QZSS, and BeiDou
- GNSS-SDRLIB: Introduction of an open source software GNSS receiver



MULTI GNSS ASIA



# Gifts from Sponsors for RTKLIB Practice

- 1. u-blox GNSS receiver (F9P)
- 2. Dual Frequency Antenna













## GNSS Software Receiver by Dr. Suzuki



#### Real-time positioning using front-end and GNSS-SDRLIB



## System Design Management (SDM), Day 5

#### System Design Engineering by Dr. N. Kohtake.

• Study the important concept to resolve the global subjects and problems using the advanced GIS technology.

### **SDM Group Discussion**

- They proposed targets and studied how to resolve the problems in 7 groups.
- The results were presented by each group.

#### SDM Group Discussion, 2019



### **On board Practice, August 2**





#### AIS & ECDIS Demo by JRC Team



Laboratory of Satellite Navigation Engineering



#### Yayoi Maru



#### Special Lecture and Practice by Justin Yang (Allystar)



# Special Lectures and Workshop (Day 6)

## Special Lectures

- GNSS Signal Security
- GNSS Authentication
- GNSS Raw Measurements from Android Device By Dr. Dinesh Manandhar (The University of Tokyo)



### Workshop by Participants

**Closing Ceremony** 



## Lecture on Spoofing by Dr. Manandhar



## Certificate for the Completion





#### GNSS Summer School 2019 in Tokyo

organized by Faculty of Marine Technology, Tokyo University of Marine Science and Technology (TUMSAT) co-organized by The Institute of Positioning, Nevigation, and Timing of Japan (IPNTJ)

The Faculty of Marine Technology of TUMSAT, hereby certifies that

#### Daisuke Hatta

has completed the 6-day course on GNSS to cultivate the comprehensive knowledge of GNSS, including receiver architecture and positioning software with practices and demonstrations, that was held from July 29th to August 3rd 2019 at Tokyo University of Marine Science and Technology.

The organizer : J. Touter in C. Prof. Tatsuro Tsukamoto, Dean of TUM-



TIMO

Supported by Multi-GNSS Asia, Quasi-Zenith Satellite System Services, and GEospatial and Space Technology consortium for Innovative Social Services



# Evaluation (10 Lectures and 4 Practices)

IPNTJ	Difficulty Satisfaction		1		5 5	Hard Highly Sa	tisfied	
Eval	uation	N	/lin.	Max	A	verage	Com	ment
Diffi	culty 2018	3	5.39	3.67	7	3.51	Bit h	arder
	2019	3	5.48	4.00	)	3.74		
_ Satis	faction	4	.03	4.48	8	4.28		
	2019	4	03	4.56	5	4.37		
Total	Impression		4	5		4.73		
	2019		3	5		4.62	(	MGA

MULTI GNSS ASIA



# Outline of Summer School in 2020

- Date : 2020/09/07-09/12 (TBC) : 6 days
- Attendees : Japanese and foreign students of post graduate level & young engineers and instructors who are teaching GNSS in their own countries.
- Number of participants : 40
- Scholarship for up to 20 foreign attendees
- Language : English



- Fee : 60,000JPY, (20,000JPY for students).
- Supported by : MGA(Multi-GNSS Asia), GESTISS (Geospatial and Space Technology Consortium for Innovative Social Service), QZSS Services
- Sponsored by Japan Science and Technology Agency (JST)

Laboratory of Satellite Navigation Engineering

# Scholarship Application

- Please prepare the following items. The scholarship includes round trip ticket, 7-night accommodation 6-day lunch and the fee.
- 1. CV
- 2. Certification of the graduation. (for your all career)\*
- 3. Transcript with student's records. (for your all career)\*
- 4. Certification for English ability (Score of TOEFL, IELTS or TOEIC)\*
- 5. Recommendations by two responsible persons\*
  \*Please attach the scanned original documents to email to <a href="mailto:yasuda@karyodai.ac.jp">yasuda@karyodai.ac.jp</a> for the selection and bring the originals if accepted.
- Call for application will be announced early 2020.
- Please check <a href="http://www.gnss-pnt.org/index.html">http://www.gnss-pnt.org/index.html</a> time to time.



MULTI GNSS ASIA



**QZSS** Services



