International GNSS Summer School in Tokyo since 2013

• **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)
GNSS Summer School 2019 in Tokyo

- **Period**: 2019/07/29 - 08/03
- **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](https://www.jrc.co.jp/jp/index.html)
  - QSS [http://www.qzs.jp/](http://www.qzs.jp/)
  - u-blox [https://www.u-blox.com/ja](https://www.u-blox.com/ja)
Outline of International Summer School

• Date: 2019/07/29-08/03: 6 days
• Organized by: Tokyo University of Marine 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

<table>
<thead>
<tr>
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<th>Mo.</th>
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<th>Mo.</th>
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**Total 110**

JST Supporting Countries

( # ): JST Scholarship Awarded #
Countries and Regions Eligible for Invitation by JST

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.
Participants in 2013-2019

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2019 Participants
22 of them are invited, selected from over 100 applicants for the scholarship.
*Include one foreign student studying in Japan.
Group Photo, August 1st, 2018
# Time Table in 2019

<table>
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<tr>
<th>Time</th>
<th>29-Jul (Monday)</th>
<th>30-Jul (Tuesday)</th>
<th>31-Jul (Wednesday)</th>
<th>1-Aug (Thursday)</th>
<th>2-Aug (Friday)</th>
<th>3-Aug (Saturday)</th>
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<td>0830-1000</td>
<td>Introduction</td>
<td>Class B-1</td>
<td>Class C-1</td>
<td>Class B-5</td>
<td>Practice for System Design, followed by SD-workshop</td>
<td>GNSS Signal Security****</td>
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<tr>
<td>1000-1010</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
<td>Class B-6</td>
<td>Lunch 1200-1240</td>
<td>GNSS Authentication****</td>
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<tr>
<td>1010-1140</td>
<td>Class A-1</td>
<td>Lunch</td>
<td>Lunch</td>
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<td>Port Cruise G-I</td>
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<td>Lunch</td>
<td>Class C-2</td>
<td>Class C-6</td>
<td>Marine Museum G-I</td>
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<td>1230-1400</td>
<td>Class A-2</td>
<td>Class B-3</td>
<td>Class C-3</td>
<td>RTK-LIB Practice</td>
<td>Practice for System Design, followed by SD-workshop</td>
<td>GNSS Signal Security****</td>
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<td>Lunch 1200-1240</td>
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<tr>
<td>1410-1540</td>
<td>Class A-3</td>
<td>Lunch</td>
<td>Class C-4 SDR I</td>
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<td>Port Cruise G-II</td>
<td>Marine Museum G-I</td>
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<td>Lunch</td>
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<td>Class C-4 SDR I</td>
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<td>Parcel Participants Workshop</td>
<td>Break</td>
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<td>1550-1720</td>
<td>QZSS-Intro &amp; Demo*</td>
<td>Septentrio Seminar***</td>
<td>Class C-5 SDR II</td>
<td>ALLYSTAR Seminar*****</td>
<td>Farewell party</td>
<td>***by Dr. Dinesh Manandhar</td>
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<td>1 class=90 minutes</td>
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<td></td>
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</tbody>
</table>

### Instructor

- **ublox**
- **JRC**
- **septentrio**
- **FURUNO**

### Summary

- **Introduction:** Dr. Akio Yasuda
- **Class-A Fundamentals:** Dr. N. Kubo & Dr. Feng-Yu Chu, A-1,2
- **Class-B Software:** Dr. Ivan G. Petrovski, A-3,4
- **Class-C Receiver:** Dr. Takeyasu Sakai, B-1,2,3,4
- **Class-C Software:** Mr. Tomoji Takasuk B-5,6, Practice
- **Class-C Receiver:** Dr. Toshiaki Tsujii, C1,2,3
- **Class-C Receiver:** Dr. Taro Suzuki, C4, SDR-Practice
- **QZSS Service:** * by QZSS Group

### Additional Notes

- **Status of GIONET, CORS in Japan by H. Matsumura**
- **GNSS Receiver Practice by Jan De Turck**
- ****by Justin Yang
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
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.)
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
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.)

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
Gifts from Sponsors for RTKLIB Practice

1. u-blox GNSS receiver (F9P)
2. Dual Frequency Antenna
GNSS Software Receiver by Dr. Suzuki

GNSS L1 C/A Base Band Signal of 2 M sps

GNSS-SDRLIB installed
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

Yayoi Maru
This EVK could output GPS/QZS L1 L2 L5 BDS B1 B2 B3 GAL E1 E5 GLO L1OF L2OF raw data in standard RTCM protocol. It can run on RTKLIB in real time. besides, our EVB could support QZS L6D already
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 of the 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, Navigation, 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:    [Signature] Prof. Tatsuro Tsukamoto, Dean of TUMSAT

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)

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<th>Max</th>
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<td>Satisfaction</td>
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Outline of Summer School in 2020

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• Sponsored by Japan Science and Technology Agency (JST)
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 yasuda@kaiyodai.ac.jp for the selection and bring the originals if accepted.

- Call for application will be announced early 2020.
- Please check http://www.gnss-pnt.org/index.html time to time.