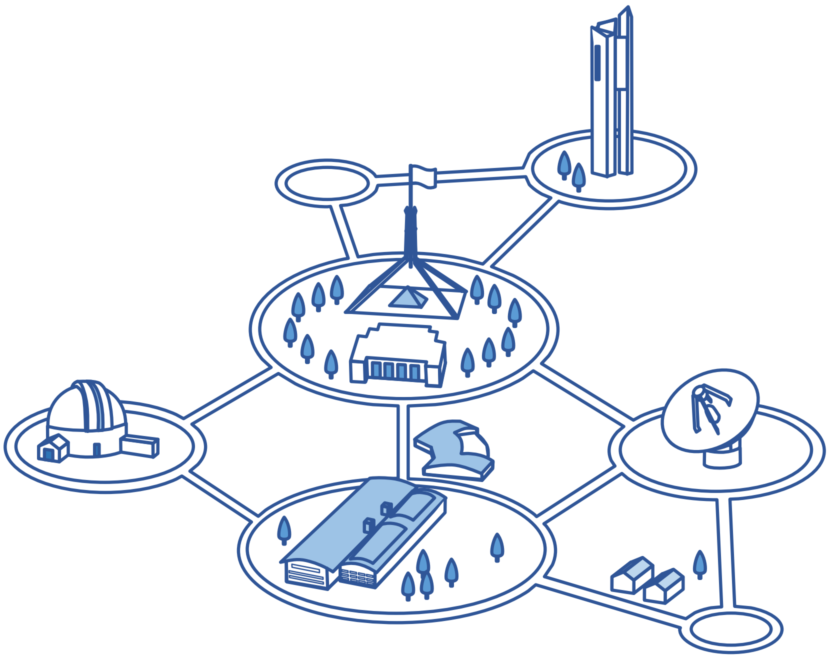
3rd General Meeting

of the Asia-Oceania VLBI Group for Geodesy and Astrometry

November 9-10, 2018

Canberra, Australia



Participants List

Name	Country	Institute
Shinji Horiuchi	Australia	Canberra Deep Space Communication Complex
Chris Phillips	Australia	Commonwealth Scientific and Industrial Research Organisation
Gary Johnston	Australia	Geoscience Australia
Nicholas Brown	Australia	Geoscience Australia
Ryan Ruddick	Australia	Geoscience Australia
Oleg Titov	Australia	Geoscience Australia
Warren Hankey	Australia	University of Tasmania
Simin Salarpour	Australia	University of Tasmania
Gabor Orosz	Australia	University of Tasmania
Fengchun Shu	China	Shanghai Astronomical Observatory
Bo Xia	China	Shanghai Astronomical Observatory
Takahiro Wakasugi	Japan	Geospatial Information Authority of Japan
Masafumi Ishigaki	Japan	Geospatial Information Authority of Japan
Toshimichi Otsubo	Japan	Hitotsubashi University
Takaaki Jike	Japan	National Astronomical Observatory of Japan
Sergei Gulyaev	New Zealand	Auckland University of Technology
Michael Pearlman	USA	Harvard-Smithsonian Center for Astrophysics

Via Telecon

Mamoru Sekido	Japan	National Institute of Information and Communications Technology
Phrudth Jaroenjittichai	Thailand	National Astronomical Research Institute of Thailand

Alphabetical by country

Conference Program

The 3rd General Meeting of the AOV is held at Canberra, Nov. 9 – 10, 2018.

- Schedule

Day 1 --November 9 (Friday)

+ 9:30 - 10:30 Opening and Discussion 1
  - 9:30 - 9:50 Opening remarks by Nicholas Brown
  - 9:50 - 10:30 Observing Status
+ 10:30 - 11:00 Coffee Break
+ 11:00 - 12:00 Discussion 2
  - 11:00 - 12:00 Observing Status
+ 12:00 - 13:00 Lunch Break
+ 13:00 - 14:00 Discussion 3
  - 13:00 - 14:00 VGOS in AOV
+ 14:00 - 14:30 Coffee Break
+ 14:30 - 15:30 Discussion 4
  - 14:30 - 15:00 VGOS in AOV
  - 15:00 - 15:30 Future Plan
+ 15:30 - 16:00 Guided Tour to Tsunami monitor system
+ 18:00 - 20:00 Conference Dinner at a Chinese restaurant “Yat Bun Tong”

Day 2 --November 10 (Saturday)

+ 9:30 - 10:40 Opening and Session 1
  - 9:30 - 9:40 Welcome remarks by Gary Johnston
  - 9:40 - 10:00 Current Trends and Challenges in Satellite Laser Ranging and its Role in GGOS, Michael Pearlman
  - 10:00 - 10:20 GGOS Working Group of Japan, Toshimichi Otsubo
  - 10:20 - 10:40 Indirect Determination of the System Invariant Reference Point of VLBI Observing Systems, Ryan Ruddick

+ 10:40 - 11:10 Coffee Break

+ 11:10 - 12:10 Session 2
  - 11:10 - 11:25 Current activities in New Zealand's Warkworth Radio Astronomical Observatory, Sergei Gulyaev
  - 11:25 - 11:40 Scientific report on AOV sessions in 2017-2018, Oleg Titov
  - 11:40 - 11:55 Status report of GSI, Masafumi Ishigaki
  - 11:55 - 12:10 Current status of VERA geodetic analysis system, Takaaki Jike

+ 12:10 - 13:10 Lunch Break

+ 13:10 - 14:15 Session 3
  - 13:10 - 13:30 Activity report of NICT/Kashima VLBI group, Mamoru Sekido (via Telecon)
  - 13:30 - 13:45 SHAO report, Bo Xia
  - 13:45 - 14:00 Legacy, VGOS and mixed-mode observations with the AuScope Array, Warren Hankey
  - 14:00 - 14:15 CDSCC report (title provisional), Shinji Horiuchi

+ 14:15- 14:45 Coffee Break

+ 14:45 - 16:10 Session 4
  - 14:45 - 15:00 Updates on the RANGD project, Phrudth Jaroenjittichai (via Telecon)
  - 15:00 - 15:15 The next-generation VLBI observations and Source Structure effects, Simin Salarpour
  - 15:15 - 15:30 Contribution of AOV observations to the ICRF3, Fengchun Shu
  - 15:30 - 15:45 MultiView VLBI Astrometry at Low Frequencies, Gabor Orosz
  - 15:45 - 16:00 Discussion and Closing

Agenda of Group Discussion

<u>November 9 (Friday)</u>

Observing Status (9:30 - 12:00)

- Observing status and issues
- Observing schedule 2019
- Science, R&D sessions
- Analysis of AOV sessions
- AOV ops mailing list
- Making good use of large telescopes

VGOS in AOV (13:00 - 15:00)

- Observing status
- Correlation status
- Mixed mode in UTAS
- Sub-group (New mailing list?)

Future Plan (15:00 - 15:30)

- Next meeting

Abstracts

Keynote Speech

Operation of SLR and VLBI *(title provisional)*

Gary Johnston (Geoscience Australia)

TBD

Current Trends and Challenges in Satellite Laser Ranging and its Role in GGOS

Michael R. Pearlman[1], Graham M Appleby[2], Giuseppe Bianco[3], Carey Noll[4], Erricos Pavlis[5] (1 Harvard-Smithsonian Center for Astrophysics, Cambridge MA, United States, 2 NERC Space Geodesy Facility, Herstmonceux, UK, 3 Centro di Geodesia Spaziale "G. Colombo", Agenzia Spaziale Italiana, Matera, Italy, 4 NASA Goddard Space Flight Center, Greenbelt MD, United States, 5 University of Maryland, Baltimore MD, United States)

Satellite Laser Ranging (SLR) is one of the fundamental Space Geodesy techniques, along with VLBI, GNSS and DORIS, that we use to maintain and improve the reference frame, which is the basis for all of our metric measurements over space, time, and evolving technology. The primary data products of SLR are Precision Orbit Determination (POD) and Time History of Station Positions and Motions for altimetry, gravity field modeling, Earth rotation, fundamental constants and many other applications that are of interest to the Global Geodetic Observing Systems (GGOS). It also supports space engineering applications, accurate time transfer, lunar science, and tracking of space debris. SLR is unique among the space geodesy techniques since it is the only one that operates in the optical region and the only one that measures the range to satellites directly. The integration of new technologies and procedures and the fielding of new SLR sites is improving SLR data and data products; new stations in process and planned for implementation

over the next several years will significantly enhance the measurement capability. On the other hand, serious voids in global distribution and the present mix of new and old technologies and operating conditions oppose challenges.

In this talk we will review the SLR Technique, its coordination by the International Laser Ranging Service and its role within GGOS. We will also discuss some of the new emerging technologies, the expanding constellations of satellites, and the projected expansion of the network of co-located space geodesy sites.

GGOS Working Group of Japan

Toshimichi Otsubo[1], Barasa Miyahara[2] and GGOS Working Group of Japan (1 Hitotsubashi University, 2 Geospatial Information Authority of Japan)

The “GGOS Working Group” was formed in Japan in 2013. Helped by a number of institutes and organizations, we organised the Geodetic Site List where 7 geodetic sites in Japan and Antarctica were included. Each site has at least one VLBI or SLR station, all collocated with a GNSS station. One of them has a DORIS antenna and some have a gravimeter. The list was submitted to the GGOS bureau and all sites were approved as GGOS sites. It should be noted that 6 different institutes own and operate these sites. Each of them has its own backgrounds and missions but all of them have worked in collaboration. The GGOS WG of Japan, as the first GGOS Affiliate, strives to improve the quality and productivity of our geodetic stations, to encourage the collaboration beyond each technique, and to make/help strategic projects for the future.

Indirect Determination of the System Invariant Reference Point of VLBI Observing Systems

Ryan Ruddick (Geoscience Australia)

The integrity and strength of multi-technique terrestrial reference frames, such as realisations of the International Terrestrial Reference Frame, depend on the precisely measured and expressed local-tie connections between space geodetic observing systems at co-located observatories. Australia has several observatories which together host the full variety of space geodetic observation techniques. The observational reference point of large geodetic observing systems, such as SLR and VLBI, are generally inaccessible. Therefore, Geoscience Australia developed an indirect measurement approach, using terrestrial observations, to precisely determine the invariant reference point (IVP) of SLR and VLBI telescopes. The indirect IVP determination technique involves a rigorous process of three-dimensional circle fitting to the coordinates of targets observed on the structure during rotational sequences about each of the systems' independent axes (e.g. azimuth and elevation). Geoscience Australia routinely measures millimetre accurate connections between survey monuments and geodetic observing systems at co-located observatories across Australia. The IVP derivation technique continues to be refined, looking to account for further un-modelled systematic errors.

Activity Report for each institute

Current activities in New Zealand's Warkworth Radio Astronomical Observatory

Sergei Gulyaev (Auckland University of Technology)

Current activities in New Zealand's Warkworth Radio Astronomical Observatory will be outlined along with plans for future developments with particular emphasis on the AOV support and operations.

Scientific report on AOV sessions in 2017-2018

Oleg Titov (Geoscience Australia)

A short report on scientific results from 12 AOV sessions (six sessions in 2017, and six sessions in first half of 2018) is presented.

Status report of GSI

Masafumi Ishigaki (Geospatial Information Authority of Japan)

The Geospatial Information Authority of Japan (GSI) has actively been involved in the Asia-Oceania VLBI Group for Geodesy and Astrometry (AOV) since its establishment. The Ishioka VLBI station has performed international observations including AOV sessions since 2015. GSI also makes schedules, carries out correlation and analysis, and provides feedback to participating stations in AOV sessions a few times a year in cooperation with Shanghai Astronomical Observatory (SHAO) and University of Tasmania (UTAS). In June 2018, Ishioka changed the regular S/X feed to the broadband feed and participated in broadband observations from June to September including AOV broadband experiments with the Hobart station. We report on the current status of the Ishioka station and its future plan.

Current status of VERA geodetic analysis system

Takaaki Jike (National Astronomical Observatory of Japan)

In order to open the geodetic VLBI data of VERA geodetic VLBI, status and characterristics of VERA geodetic VLBI analysis system are explained. This system is constructed for estimation of geodetic parameter from the correlation data of the the Mitaka FX correlator. To suit to time system used in existing geodetic VLBI estimation system, time system convertor is installed to the analysis system. FITSIO is I/O tool of correlatio raw data and the observed-delay data set.

Activity report of NICT/Kashima VLBI group

Mamoru Sekido
(National Institute of Information and Communications Technology)

NICT/KASHIMA VLBI Group is participating to IVS and AOV observations with Kashima 34m, Kashima 11m, and Koganei 11m VLBI stations. In addition to the regular geodetic VLBI experiments, we have been engaged in VLBI technology development as a IVS Technology Development Center. Our current target of development is broadband VLBI system for application to long distant precise frequency transfer. That system named GALA-V is broadband VLBI system composed of small (2.4m diameter) broadband VLBI station (MBL) as the node and joint observation with high sensitivity antenna for boosting SNR of the network observation. After a series of domestic experiment until 2018, we have exported one small VLBI station to Italy to examine the system for intercontinental VLBI experiment. This presentation will report about current activity of our group.

SHAO report

Bo Xia (Shanghai Astronomical Observatory)

The Shanghai Astronomical Observatory (SHAO) has been involved in the AOV activities by contributing observing time of Tianma65 and Seshan25, and sharing scheduling and correlation load. This report will outline recent geodetic activities conducted at SHAO and report our plans in the near future, with emphasis on the AOV activities.

Legacy, VGOS and mixed-mode observations with the AuScope Array

Warren Hankey (University of Tasmania)

With the permanent installation of the wideband receiver of the Hobart12 telescope last year, we have made a major change to our capabilities with the AuScope array. Despite some setbacks and difficulties, we have made significant progress in developing towards VGOS, assisted by our collaborations with the Ishioka and Kashima observatories.

While our main focus has been on bringing the Hobart12 system into operation as a VGOS station, we have also been investigating the inter-operability of our new system with the "legacy" S/X system.

In this talk we present the current status of the AuScope array and the results of our "mixed-mode" observations using both the S/X and wideband systems.

CDSCC report *(title provisional)*

Shinji Horiuchi

TBD

Updates on the RANGD project

Phurdth Jaroenjittichai (National Astronomical Research Institute of Thailand)

National Astronomical Research Institute of Thailand (NARIT) has embarked on another challenging mission to establish research and development in radio astronomy and VLBI geodesy via the umbrella project, "Radio Astronomy Network and Geodesy for Development" (RANGD). For phase I (2017-2021), the project includes the constructions of the 40-m Thai National Radio Telescope (TNRT) and a 13-m VGOS antenna, electronics and RF labs and the visitor and education centre for the public. Both co-located telescopes will form a VLBI observatory which will allow significant contributions to astronomy and geodesy community and VLBI networks. Astronomical receivers at L- and K-band wavelengths, ku-band microwave holography receiver and state-of-the-art software backend are being developed and will be installed and commissioned together with the TNRT later in 2019. The 13-m VGOS telescope will come on-line in the early 2020. Electronics and RF labs and equipment are being deployed for maintenance and to accommodate future self-sustained technological development. Receivers for TNRT at C-, Q- and W-band wavelength are also being planned.

Contribution Talk (Research and Science)

The next-generation VLBI observations and Source Structure effects

Simin Salarpour (University of Tasmania)

To determine accurate celestial and terrestrial reference frames, next-generation VLBI observations will face a very important issue which is called source structure. Quasar structure is a highly dependent variable to frequency and time. This issue is a big challenge for observing over a wide range of 2-14 GHz which is one of VGOS' aims. For the same source, structure effects can be distinct at different frequencies. So far, research on source structure effect in VGOS has been sparse.

During my PhD, I intend to investigate source structure, both theoretically and observationally. Using automatically extracted information from source images, we can calculate visibility phase changes over the broadband frequency range. On the example of J0136+4751, we can then calculate the source structure effects as a function of frequency and time for varying geometries. Using simulated global or regional VGOS networks, this approach allows us to give estimates about the number of observations within a session that may be affected by source structure, in dependence of the source's activity cycle as well as baseline length and observing geometry.

We will also briefly discuss opportunities within the AOV to further support research on source structure and for the success of VGOS observations.

Contribution of AOV observations to the ICRF3

Fengchun Shu (Shanghai Astronomical Observatory)

The AOV network is unique to astrometry of radio sources in the middle southern hemisphere and the ecliptic plane. In the first 3 years of AOV observing sessions, we have observed more than 200 target sources. 194 sources have been included in the ICRF3 catalog released in August 2018. We find there are 145 sources matching with Gaia DR2 objects within 0.1 arc second. Compared with the ICRF2, the ICRF3 has 1122 new sources. Among them, 149 sources (13.3%) were observed by the AOV sessions, and 132 sources have been firstly observed by the AOV. In order to observe more sources and reduce their positional uncertainties, we need to continue AOV astrometric sessions.

MultiView VLBI Astrometry at Low Frequencies

Gabor Orosz (University of Tasmania)

Observations at low VLBI frequencies are dominated by direction-dependent ionospheric propagation errors, which place a tight limit on the angular separation of suitable phase referencing calibrators for relative astrometry. MultiView is a multi-calibrator phase-referencing solution that can help compensate for atmospheric spatial-structure errors by characterizing the two-dimensional phase screen around the target, which results in increased astrometric accuracy and more relaxed constraints on the angular separation of calibrators. In my talk, I will introduce VLBI tests of MultiView and discuss the applicability of direction-dependent phase calibration for various topics in astrophysics.