

FIG Commission 5

Annual Report of Activities 2015

1. General

The Commission 5 2015-18 work plan consists of realising tangible outcomes for our already well-known FIVE missions, which are -

- FOCUS on modern technologies, technical developments and applications.
- FACILITATE and follow technical developments through collaborations with other FIG Commissions and like organisations.
- FOSTER and support research and development and stimulate new ideas in the fields of expertise represented within the commission.
- FORMULATE and formalise collaboration with manufacturers on the improvement of instrumentation and associated software.
- FIG EVENTS - present and promote the work of the Commission and its working groups through technical events and necessary media.

The year 2015 for Commission 5 has been primarily focused on the technical activities for the FIG operational surveyor. Our activities have been associated with the technical programme for the FIG 2015 Working Week in Sofia. The FIG/IAG/ICG/UN-GGIM-AP Reference Frame in Practice Technical Seminars were held in conjunction with the South East Asia Survey Congress (SEASC 2015) in Singapore. We have also continued our effective collaboration with our international sister organisations to promote and fulfil the FIG objectives and the FIVE missions of our work plan, especially at the Pacific Geospatial and Surveying Council Meeting and GIS/ RS User Conference in Suva, Fiji. Furthermore, the Commission has been preparing the next FIG Technical Seminar on Reference Frame prior to FIG Working Week 2016 in Christchurch (1-2 May 2016).

A summary of the working group activities in 2015 is as follows:

2. Working Groups

WG 5.1 – Standards, Quality Assurance and Calibration

Chaired by David Martin

Standards play an important role in surveying. This is particularly true with modern instrumentation where the details and how measurement results are produced are not fully understood by the average practicing surveyor. Even if they are not directly implicated, they are very reliant upon standards underpinning the correct functioning of their instruments.

Working Group 5.1 has actively participated and will continue to participate in the development of technical sessions and creation of presentations for technical seminars and Working Weeks.

Working Group 5.1 continues to be the contact for FIG liaison to the ISO Technical Commission (TC) 211 (<http://www.isotc211.org/>) and Technical Committee ISO/TC 172/SC 6. Presently, Nic Donnelly, from Land Information New Zealand, is the FIG liaison to TC211.

Recall, TC 211 is concerned with standardization in the field of digital geographic information. This commission aims to establish a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to the Earth. These standards may specify, for geographic information, methods, tools and services for data management (including definition and description), acquiring, processing, analyzing, accessing, presenting and transferring such data in digital/electronic form between different users, systems and locations. The work links to appropriate standards for information technology and data where possible, and provides a framework for the development of sector-specific applications using geographic data.

ISO/TC 172/SC 6 deals more closely with classical surveying instruments. Standards deal with field procedures for testing geodetic and surveying instruments such as theodolite, total stations levels and GNSS in real-time kinematic (RTK). Several of these standards are presently being revised.

A principal aim of Working Group 5.1 remains the examination and promotion of guidelines and recommendations for standards and quality in survey measurements based on the ISO Guide to Uncertainty in Measurement (GUM) and its supplements.

WG 5.2 – 3D Reference Frames

Chaired by Nic Donnelly

The 3D Reference Frames Working Group is a successor to Commission 5's previous "Reference Frames in Practice" group. As such, it maintains a very practical focus on helping the surveying and spatial community understand and utilise 3D reference frames (or datums). A 3D reference frame (also known as a geometric reference frame) is often realised by stations with X, Y and Z geocentric coordinates, or latitude, longitude and ellipsoidal height. There are very close linkages with WG 5.3 – Vertical Reference Frames, which covers on physical heights.

Technical issues covered by this Working Group include global and local 3D reference frames, relationships between them, infrastructure and software to realise them and their use to support spatial positioning. There is also a focus on the relationships between 3D and vertical reference frames.

A key focus for this year has been education, with two workshops being run on the topics of vertical reference frames (in conjunction with WG5.3) and kinematic reference frames. The Technical Seminar on Vertical Reference Frames in Practice was held in Singapore from 27-28 July 2015, immediately before the South East Asian Survey Congress. Topics covered included the theory of vertical reference frames and physical height systems, airborne gravity, vertical deformation and case studies from a number of countries. There were about 20 participants from around the world, including a number from developing countries supported by the International Committee on GNSS (ICG), part of the United Nations Office of Outer Space Affairs (UNOOSA). The workshop was run with the support of partner organisations:

the International Association of Geodesy (IAG), the United Nations Initiative on Global Geospatial Information Management for Asia-Pacific (UN-GGIM-AP) and the Singapore Land Authority (SLA). The event was also well-supported by corporate sponsors Trimble and Leica.

A second technical seminar is planned for the two days preceding the 2016 Working Week in Christchurch. This will focus particularly on kinematic reference frames and deformation, issues of particular relevance to this part of the world. Once again, there is strong support from partner organisations and particular efforts are being made to support attendees from the Pacific Islands and other developing nations.

WG 5.3 – Vertical Reference Frames

Chaired by Kevin M. Kelly and Dan Roman

At the 2014 FIG Congress in Kuala Lumpur, Commission 5 established a new working group, WG5.3 – Vertical Reference Frames (VRF). Although Commission 5 has WG 5.2 – 3D Reference Frames, it was felt that the importance and unique issues involving heights and height systems justified its own dedicated working group. Some, although not all, of these issues include environmental ones like sea level rise and other geodynamic processes, climate change, etc. Among the more practical geodetic issues that WG5.3 – VRF will address include: relationships and links between land-based vertical datums and ocean tidal datums, gravimetric geoid based national vertical reference systems (or datums), regional and global height system unification, ongoing deterioration of classical vertical control networks, usefulness of existing leveling data, and of course, GNSS heighting. Our aim is to provide tools so that geomatics practitioners can effectively understand and use VRF's in their day to day work or implement VRF's in their national jurisdictions.

As WG5.3 is brand new, focus has been on building its membership. To date WG5.3 has 10 members representing Africa, Asia, Central America, Europe, New Zealand and U.S.A. Although organized and put on by WG5.2, the technical program and suggested speakers for *Technical Seminar on Vertical Reference Frames*, held 27-28 July 2015 in Singapore was designed by WG5.3. WG5.3 will also participate in the FIG Commission 5 *Technical Seminar on Reference Frames in Practice* to be held at the 2016 FIG Working Week in Christchurch, New Zealand with two invited speakers: Dr. Bill Kearsly from University of New South Wales and Mr. Kevin Kelly from Esri.

WG 5.4 – GNSS

Chaired by Neil D. Weston and Suelynn Choy

WG 5.4 was active at the 2015 FIG Working Week in Sofia with five technical sessions on GNSS specific topics:

1. Atmospheric Application of GNSS (dedicated session)
2. GNSS Precise Point Positioning (PPP)
3. Multi-GNSS and GNSS Specialities
4. Geo-Dynamics and GNSS Analysis
5. GNSS for Monitoring (joint Commission 5 and 6 session)

GNSS plays a vital and growing role in areas as diverse as transportation, agriculture, surveying and engineering, mapping, emergency services, as well as geophysical and atmospheric research. Over the next five years, there will be a surge of new GNSS and RNSS satellites launched: the U.S. modernised GPS constellation, Russia’s revitalised GLONASS, European Union’s Galileo, China’s BeiDou, Japan’s QZSS and India’s IRNSS systems. Multi-frequency multi-constellation GNSS is active topic as multi-GNSS provides improved performance over those of a standalone system in terms of accuracy, availability, continuity and reliability. The advent of PPP technique and online processing services have also attracted the attention of many GNSS users.

WG 5.4 aims to provide practitioners with up-to-date information on the rapid development of multi-GNSS and advancement in GNSS precise positioning techniques. An article of the current performance of PPP technique and its future prospects has been prepared and is currently under review for publication. WG 5.4 is also in close collaboration with IAG WG 4.4.2 on “Integer Ambiguity Resolution for Multi-GNSS PPP and PPP-RTK”.

NOAA’s National Geodetic Survey Hosted 2015 Geospatial Summit, April 13 – 14

The National Geodetic Survey (NGS) hosted a 2015 Geospatial Summit on April 13 and 14 to share updates on the planned 2022 release of new geodetic datums being developed to replace the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88). The summit provided an opportunity for NGS to outline its road map for retiring NAD 83 and NAVD 88 and apprise participants of the tools available to ease the transition to the new, more accurate datums.

The mission of NGS, an office of the National Oceanic and Atmospheric Administration (NOAA), is to define, maintain, and provide access to the National Spatial Reference System (NSRS— the consistent coordinate system that defines latitude, longitude, height, scale, gravity, and orientation throughout the United States and is designed to meet the nation’s economic, social, and environmental needs. At the summit, NGS provided plans to meet this mission in the future through defining new geometric (horizontal) and geopotential (vertical) datums. NGS shared strategies to better enable the mapping and surveying communities and other constituents to prepare well ahead of time, thus facilitating a smooth transition and minimizing the impact the new datums will have on these and other related industries.

Surveyors, GIS professionals, federal, state, and local government agencies, university students and educators and other interested parties participated and shared their comments, questions, and concerns regarding the effect the new datums will have on their work.

WG 5.5 – Multi-Sensor-Systems

Chaired by Allison Kealy and Günther Retscher (IAG)

WG5.5 is a joint working group between FIG and IAG. It focuses on the development of shared resources that extend our understanding of the theory, tools and technologies applicable to the development of multi sensor systems. It has a major focus on:

- Performance characterization of positioning sensors and technologies that can play a role in augmenting core GNSS capabilities

- Theoretical and practical evaluation of current algorithms for measurement integration within multi sensor systems
- The development of new measurement integration algorithms based around innovative modeling techniques in other research domains such as machine learning and genetic algorithms, spatial cognition etc.
- Establishing links between the outcomes of this WG and other IAG and FIG WGs (across the whole period)
- Generating formal parameters that describe the performance of current and emerging positioning technologies that can inform FIG and IAG members.

In 2015, members of this working group participated actively in the following events:

- The Institute of Navigation (ION) Pacific PNT conference, Hawaii.
- The Institute of Navigation (ION) GNSS+ conference, Florida.
- Mobile Mapping Symposium, Sydney.
- FIG Working Week, Sofia.
- IUGG, Prague.
- Geomatics Indaba, Johannesburg.
- IGNSS, Surfers Paradise.
- Emparco Workshop, Athens.
- IPIN, Banff.

WG 5.6 – Cost Effective Positioning

Chaired by Leonid A. Lipatnikov

The working group WG 5.6 was established in 2015 to continue successful efforts of the Special Study Group “Cost-Effective GNSS” within WG 5.4 “GNSS”. The main policy issues for WG 5.6 are education on when to use which surveying instrument or evaluation software taking into account economic reasons, designing fit-for-purpose cost-effective surveying systems and support to decision makers for establishing cost-effective positioning solutions.

In 2015 development of guidelines for cost-effective use and design of survey solutions including costs for labour and investment was initiated. The guidelines are intended to become a practice-oriented complementation to previous publications including FIG paper 49 “Cost Effective GNSS Positioning Techniques” by Neil D. Weston and Volker Schwieger. The concept of the guidelines has been shaped. Currently preparation of material is under way along with efforts to raise awareness and involve experts in the particular field as co-authors. WG 5.6 was presented at the International Seminar on Geo-Information Technology in Central Asia held in Urumqi, China on 28–30 September 2015. Participation in the Interexpo GEO-Siberia in Novosibirsk and the FIG Working Week in Christchurch is scheduled for 2016.

3. Cooperation, Seminars and Workshops

3.1 Cooperation with Other Commissions

During the 2015 period Commission 5 collaborated with other FIG Commissions as required. This cooperation primarily consisted of holding joint technical sessions (e.g. Terrestrial Laser Scanning at Working Week in Sofia) and meetings at FIG-related events as well as co-sponsoring symposia. For example, FIG Commission 5's alliance with Commission 6 to address contemporary issues relating to Terrestrial Laserscanning (TLS), deformation measurement, calibration of instruments, long range measurement, satellite and terrestrial imagery measuring techniques.

3.2 Cooperation with Sister Organisations

Commission 5 has continued to maintain a successful working relationship with the International Association of Geodesy (IAG), the ION and the ISPRS. This was achieved by convening joint Technical Seminars on Reference Frames in Practice, technical sessions and holding joint administrative meetings on significant issues. Additionally multidirectional exchange on Seminars and Symposia are practised e.g. FIG Commission 5 Chair Volker Schwieger participated at the IAG-EUREF Symposium June 3-5 2015 in Leipzig. He gave a presentation on "The Contribution of FIG to Reference Frames" presenting the FIG, especially Commission 5 and their relations to static as well as kinematic reference frames.

During 2015, the following events were held with sister organisations;

- FIG/IAG/ICG/UN-GGIM-AP/SLA Technical Seminar on Vertical Reference Frame in Practice in Singapore
- Pacific Geospatial and Surveying Council Meeting and GIS/ RS User Conference in Suva, Fiji

Report on FIG/IAG/ICG/UN-GGIM-AP/SLA Technical Seminar on Vertical Reference Frame in Practice in Singapore

The Technical Seminar on Vertical Reference Frames in Practice was held in Singapore on 27-28 July 2015. The seminar had a particular focus on vertical reference frames, in response to requests from the region. This complemented a previous seminar held in Manila in 2013, which focussed on 3D frames. It was organised by FIG Commission 5, in conjunction with the International Association of Geodesy (IAG), the International Committee on GNSS (ICG), the United Nations Initiative for Global Geospatial Information Management for Asia-Pacific (UN-GGIM-AP) and the Singapore Land Authority (SLA). Organisational representatives were as follows: Nic Donnelly (FIG), Chris Rizos (IAG), Sharafat Gadimova (ICG), John Dawson (UN-GGIM-AP), Victor Khoo (SLA).

The seminar was held in conjunction with the 13th South East Asian Survey Congress at the Marina Bay Sands Convention Centre. Local organisational support was provided by Victor Khoo and Richard Loo of the Singapore Land Authority. There were 22 participants, including presenters, from around the world. Countries represented included Singapore, Japan, Pakistan, Fiji, Australia, New Zealand, Nigeria, Hong Kong, Poland, France and Austria. Attendees represented a mix of academic, government and commercial institutions. The seminar focussed on the theory and practice of vertical reference frames. Topics covered included: Introduction to Vertical Reference Frames, Time Dependence and Transformations,

Airborne Gravity Data Collection and Analysis, International GNSS Service, Vertical Deformation, GNSS Heighting, Case Studies Australia Hong Kong Japan New Zealand Singapore.

There were excellent opportunities to network and socialise during the lunch and tea breaks, which the participants took advantage of. One of the highlights of the seminar was the dinner held on the first evening, facilitated by our Singaporean hosts. Dinner was held at Satay by the Bay and provided an opportunity to sample a number of local dishes and continue the networking. The seminar was well supported by Leica and Trimble, in terms of both financial support and attendance. The ICG provided financial support to several participants from developing nations.

Report on the Pacific Geospatial and Surveying Council Meeting

The 2nd Pacific Geospatial and Surveying Council (PGSC) meeting was held on the 19 – 20 November 2015 at the premises of the Secretariat of the Pacific Community (SPC) in Nubua, Suva. The meeting was co-organised by The Australian Government’s Climate and Oceans Support Program in the Pacific (COSPAc) and SPC Geoscience Division. FIG Commission 5 representative Rob Sarib and United Nations Global Geospatial Information Management (UN GGIM) spokesperson, John Dawson (also from Geoscience Australia), were invited to participate in discussions by contributing to the workshop development of a “strategy document” for the PGSC.

The PGSC was established in November 2014 and comprises of Pacific Island surveyors, hydrographers and geospatial scientists. The PGSC developed a Charter in response to the FIG Small Islands Developing States (SIDs) Suva Statement on Spatially Responsible Governance. The PGSC Charter was formulated to recognise regional challenges and the opportunities to improve capacity building, knowledge and data sharing, and the appreciation and enhancement of co-operation for responsible governance of tenure of land, fisheries and forest, of geospatial (and survey) infrastructure and information management. To date, 11 of the 14 participating countries have endorsed the PGSC Charter and it is expected the PGSC Strategic and Action plans will be finalised in the next 6 months.

It has to be mentioned that the adoption of the United Nations (UN) resolution, initiated by the Republic of Fiji, on Global Geodetic Reference Frame for Sustainable Development at the UN General Assembly on 26 February 2015, may have provided the much needed political will and momentum for this regional action.

From an FIG perspective the work done by the PGSC needs to be acknowledged as the effort, the desire to succeed and the political will is evident. The PGSC through the development of their strategy plan are aligned the global sustainable development agenda, building the capacity of surveyors for change, and the importance of regional collaboration. It is also apparent that PGSC members are cognisant of the need for regional surveyors to measure, monitor and analyse the tangible or real effects of climate change (such as sea level rise) on achieving sustainable development. The PGSC and Pacific Island Countries and Territories are aware of the social, economic, environmental and technological challenges ahead, and look forward to any support that FIG can provide to assist fellow professionals in this region.

For more information refer to the report at web location –

http://www.fig.net/news/news_2015/2015_11_GIS_RS-User_Conf.asp

3.3 Cooperation with UN

As mentioned partly in 3.2 strong collaboration is also realized with different branches of the United Nations (UN): the United Nations Global Geospatial Information Management – Asia Pacific (UN GGIM-AP) and the International Committee on GNSS (ICG). The joint Technical Seminar was held in July at Singapore (see 3.2). Additionally the UNOOSA ICG held its annual meeting in Boulder, US in early November. Neil Weston and Mikael Lilje represented FIG.

Most important, the UN Resolution *Global Geodetic Reference Frames for Sustainable Development* was endorsed in February. This is the first UN Resolution concerning geospatial information and is a result of the successful work of UN GGIM and its working group on Global Geodetic Reference Frame. For more information, documents, newsletters and videos please visit http://ggim.un.org/UN_GGIM_wg1.html.

For more detailed reports from these events please refer to our Commission website.

3.4 Cooperation with ISO

ISO/TC211 is the technical committee of the International Organization for Standardization that deals with geographic information, including geodetic datums and reference frames. Nic Donnelly is the FIG Special Liaison to ISO/TC211. In the geodesy sphere, there are several initiatives of interest to FIG underway.

Firstly, an international standard (ISO19127) has been drafted which defines requirements for a geodetic registry. Secondly, a geodetic registry is being developed, which will contain authoritative data on key global and national reference frames. Thirdly a new work item has been proposed to update *ISO19111 – Spatial Referencing by Coordinates* to better account for modern reference frames, such as those with deformation models and geoid models.

4. Events

2015

A summary of the Commission 5 activities at events in 2015 can be found on our website <http://www.fig.net/commission5/index.htm>

2016

In 2016 Commission 5 will endeavour to send representatives to the following conferences:

- 2016 IGS workshop, 16-19 February 2016, Sydney, Australia
- 3rd Joint International Symposium on Deformation Measurements, JISDM, 30 March - 1 April, 2016, Vienna, Austria
- Interexpo GEO-Siberia, 20-22 April 2016, Novosibirsk, Russia
- FIG/IAG/ICG/UN-GGIM-AP Reference Frame in Practice technical seminars, 1-2 May 2016, Christchurch, New Zealand
- FIG Working Week, 2-6 May, 2016, Christchurch, New Zealand
- International Workshop on Accelerator Alignment (IWAA), 3-7 October 2016 at the European Synchrotron Radiation Facility in Grenoble, France
- Machine Control & Guidance (MCG), 5-6 October 2016 in Clermont-Ferrand, France

5. Communication and Publications

Commission 5 have issued numerous reports and periodic newsletters to our delegates. These information can also be found on websites -

- <http://www.fig.net/organisation/comm/5/index.asp>

Volker Schwieger

Chair

Chair of FIG Commission 5

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