

# FIG Commission 5

## Annual Report of Activities 2016

### 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 2016 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 2016 Working Week in Christchurch. The *FIG/IAG/ICG/NZIS/UN-GGIM-AP Technical Seminar on Reference Frame in Practice* was held prior to and conjunction with the FIG Working Week 2016 on 1-2 May 2016 in Christchurch. We also convened a half-day presentation and discussion forum on reference frames as part of the *United Nations/Nepal Workshop on the Applications of Global Navigation Satellite Systems* held from 12-16 December 2016 in Kathmandu. The next Technical Seminar on Reference Frame in Practice will be held on 29-30 July 2017 in Kobe, Japan.

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. Furthermore, the Commission 5 is preparing the *FIG Cost Effective Positioning and Geo Data Seminar* with Commission 3 in conjunction with “Geosiberia” in Novosibirsk Russia (19-21 April 2017). The Commission 5 will organise a *special Session of FIG Commission 5* at the well-known international exhibition and congress “Intergeo 2017” in Berlin, Germany (26-28 September 2017).

A summary of the working group activities in 2016 is as follows:

### 2. Working Groups

#### WG 5.1 – Standards, Quality Assurance and Calibration

Chaired by David Martin

The Standards, Quality Assurance and Calibration working group continues to support ISO activities through participation in ISO/TC 211 (Nic Donnelly) and ISO/TC 172/SC 6.

At present the FIG seat is vacant on the ISO/TC 172/SC 6 which concerns Geodetic and surveying instruments. This is unfortunate as there are a number of active and very pertinent items that are – or have been recently under review - ISO/DIS 9849: Geodetic and surveying instruments – Vocabulary; ISO/FDIS 16331-1: Performance of handheld laser distance meters; ISO/CD 17123-5: Field procedures for testing geodetic and surveying instruments -- Part 5: Total stations; and SO/CD 17123-9: Field procedures for testing geodetic and surveying instruments -- Part 9: Terrestrial laser scanners. People with considerable experience and interest in surveying instrumentation and who might be interested in participating in ISO/TC 172/SC 6 should make themselves known.

Nic Donnelly is active within ISO/TC 211. ISO/TC211 is involved with Standardization in the field of digital geographic information. It 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. Key items include: an ongoing and important project aiming to establish a Geodetic Registry; a review of ISO/TS 19127:2005 Geodetic codes and parameters; and a potential review of ISO 19111:2007 Geographic Information – Spatial Referencing by Coordinates.

### **WG 5.2 – 3D Reference Frames**

Chaired by Nic Donnelly

The highlight of the year was the 2-day Technical Seminar on Reference Frames in Practice held immediately before the FIG Working Week in Christchurch. With over 50 participants, this was the largest of these seminars to date and it attracted participants from a range of countries. Financial support from UNOOSA-ICG enabled the participation of delegates from developing countries, each of whom gave a short presentation on the reference frame in their country. A fuller report on this event is provided later in this report.

Continuing the theme of outreach and education, the working group convened a half-day session at the *United Nations/Nepal Workshop on the Applications of Global Navigation Satellite Systems* held from 12-16 December 2016 in Kathmandu. This session was chaired by working group member Dr Chris Pearson. It focussed on GNSS reference frames and reference station networks, with a particular focus on Asia and the Pacific. There were presenters from Egypt, Fiji, Mongolia, Pakistan, the Philippines, Thailand and Uzbekistan. Topics covered included: geoid modelling, analysing data at GNSS stations, precise timing using GNSS and use of GNSS in national reference frames. The presentations were followed by a discussion on the role of GNSS in providing and accessing national reference frames. Details of the programme can be found at <http://www.unoosa.org/pdf/icg/2016/nepal-workshop/PROGRAMME.pdf>

### **WG 5.3 – Vertical Reference Frames**

Chaired by Kevin M. Kelly and Dan Roman

As WG5.3 is a new WG established at the 2014 FIG Congress in Kuala Lumpur, its focus to date has been on building membership and assessing level of participation by members. It's been slow to make significant progress but we hope to achieve at least a few goals of our ambitious work plan. To date WG5.3 has 10 members representing Africa, Asia, Central

America, Europe, New Zealand and U.S.A. WG5.3 maintains a good working relationship with the International Association of Geodesy (IAG).

Our first accomplishment was participation in the organization and delivery of a technical seminar on vertical reference frame as part of the WG5.2 *Technical Seminar on Reference Frame in Practice: Reference Frames, Datum Unification and Kinematics, Christchurch, New Zealand, 1-2 May 2016*. Also, although organized and put on by WG5.2, the technical program and suggested speakers for the *Technical Seminar on Vertical Reference Frames, Singapore, 27-28 July 2015* was largely designed by WG5.3.

Though ambitious, over the next two years WG5.3 hopes to address issues such as 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 educational 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.

#### **WG 5.4 – GNSS**

Chaired by Neil D. Weston and Suelynn Choy

WG 5.4 represented FIG at these conferences and gave the following presentations:

- “Status of multi-GNSS/RNSS and opportunities” at the FIG/IAG/ICG/NZIS/UN-GGIM-AP Technical Seminar on Reference Frame in Practice which was held in conjunction with the FIG Working Week 2016 on 1-2 May 2016 in Christchurch.
- “Augmenting GNSS Precise Point Positioning with Ionospheric Corrections: A Case Study in Victoria, Australia” at the 8th Multi-GNSS Asia Conference, which was held in November 2016 in Manila; and the International GNSS Conference, which was held in December 2016 in Sydney, Australia.
- “Augmenting GNSS Precise Point Positioning (PPP) for Improved Performance” at the United Nations/Nepal Workshop on the Applications of GNSS in Kathmandu, Nepal, from 12 - 16 December 2016.

An article titled “Uncovering common misconceptions in GNSS Precise Point Positioning and its future prospect” has been published in GPS Solutions in 2016. The paper provides an overview of the current performance of PPP as well as attempt to address some of the common misconceptions of this positioning technique —considered by many as the future of satellite positioning and navigation. Additionally the contribution was elected as FIG paper of the month in September 2016.

Some additional activities are mentioned in the following:

#### **A. United Nation’s Global Geodetic Reference Frame**

The Office of Coast Survey and the National Geodetic Survey, both Program Offices within NOAA, have been participating with the United Nation’s Global Geospatial Information Management (GGIM) efforts for just over two years now. Dr. Neil Weston

has been a team member of the Global Geodetic Reference Frame (GGRF) Working Group which wrote the UN Resolution. The GGRF Working Group is responsible for developing a Roadmap which describes how the UN will implement the geospatial components of the UN Resolution.

During the summer of 2016, the team rushed to complete the GGRF Roadmap before the next General Assembly. The final version was presented to the UN General Assembly in early August and describes how governments and geodetic/geospatial agencies can contribute to establishing and maintaining a Global Geodetic Reference Frame. As many of you know, having a geodetic infrastructure is critical for many geographic information systems, maps and nautical charts as well as for all positioning and navigation systems/applications. The National Geodetic Survey plays a critical role in establishing the National Spatial Reference System and considered one of the World's leaders in advancing the fields of geodesy and geoinformatics.

### ***B. GPS International Working Group***

Dr. Neil Weston attended a meeting of the GPS International Working Group (GIWG) towards the end of June which had a focus on two main topics as follows:

1. Status of the bilateral U.S.-China GNSS Dialogue
2. Status of the EU Mandate for Negotiations with the U.S. on access to the Galileo Public Regulated Service (PRS).

At the GIWG, they also discussed interagency participation on the U.S. Delegation, organization of expert support to the negotiations, and other issues that need to be addressed within the USG as we proceed towards eventual access to PRS.

### ***C. Electronic Jamming***

The Department of Homeland Security (DHS) Science and Technology Directorate (S&T) took proactive steps towards identifying and combatting electronic jamming threats by hosting the **DHS S&T First Responder Electronic Jamming Exercise**, a multi-agency operational exercise at the White Sands Missile Range in New Mexico from July 11 - 15, 2016. This exercise assessed the impact of these (GPS and GNSS) threats on first responder communications systems and mission response, and identify gaps in training, techniques and procedures. These meeting brought together participants and planning partners to share updates about the exercise planning and provide a forum to exchange ideas and questions. The Technical Working Group will be responsible for identifying, procuring and characterizing technologies for testing during the exercise as well as identifying the technical testing requirements and criteria for incorporation in the exercise scenarios. Dr. Neil Weston's role as part of this effort is strictly as a technical expert to provide guidance and some oversight.

## **WG 5.5 – Multi-Sensor-Systems**

Chaired by Allison Kealy and Günther Retscher (IAG)

In this joint WG with IAG significant progress has been made in 2016 towards the use of multi-sensor systems for localization of mobile pedestrian users in combined out- and indoor environments. A field campaign for indoor cooperative positioning was conducted at the Department of Geodesy and Geoinformation at TU Wien, Austria, in the last week of September. The lab tests concentrated on the use of Wi-Fi in conjunction with UWB as well as inertial smartphone sensors for continuous positioning of a mobile user and/or a whole user group. The work will be continued in 2017 with a field campaign at the Melbourne University, Australia, in February and at the Ohio State University, USA, in the first week of October 2017. Indoor positioning will be the major focus in the first campaign whereas the use of UAV's in combined out- and indoor environments in the second, respectively.

Several WG members were attending the FIG Working Week in Christchurch. Further highlights were the participation at the ION GNSS, IGNSS Australia, IPIN conferences. The WG is actively involved and started to prepare with the sister organizations the upcoming Mobile Mapping Technology conference to be held in Cairo, Egypt, from May 6-8, 2017.

### **WG 5.6 – Cost Effective Positioning**

Chaired by Leonid A. Lipatnikov

The working group WG 5.6 established in 2015 as a successor of the Special Study Group “Cost-Effective GNSS” deals with several policy issues including education on when to use which surveying instrument or 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 2016 WG 5.6 participated in the Interexpo GEO-Siberia, Novosibirsk, Russia, 20-22 April 2016 and in the FIG Working Week, Christchurch, New Zealand, 2-6 May 2016.

As of the end of 2016, the joint work with Neil D. Weston, Suelynn Choy and Volker Schwieger on a study devoted to GNSS Precise Cost Effective Positioning is going on. The paper to be published as a result of it is expected to lay a foundation for further developments and publications of the Working Group 5.6. Also organization of the forthcoming Cost Effective Positioning and Geo Data Seminar to be held jointly with FIG Commission 3 is in process. The seminar is seen as a good opportunity to bring producers of the survey-grade equipment, developers of precise low-cost solutions, surveyors, and other potential users together to shape a common vision for the future of cost-effective positioning technologies. The event is expected to attract new contributors to the WG 5.6 and strengthen cooperation in the sphere of development and promotion of cost-effective surveying solutions.

## **3. Cooperation, Seminars and Workshops**

### 3.1 Cooperation with Other Commissions

During the 2016 period Commission 5 collaborated with other FIG Commissions as required. This cooperation primarily consisted of holding joint technical sessions (e.g. on Terrestrial Laser Scanning, Multisensor Systems and Earthquake Monitoring and GNSS Applications at Working Week in Christchurch) 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. Additionally Commission 5 has actively participated at the *5th International Conference on Machine Control & Guidance* 5-6 October 2016 in Vichy, France and at the *International Workshop on Accelerator Alignment (IWAA)*, 3-7 October 2016 at the European Synchrotron Radiation Facility in Grenoble, France. These conferences is co-sponsored by Commission 6.

Volker Schwieger actively participated at the Commission 3 Workshop with the title *From Volume to Quality: Bridging the Gap for Spatial Data Infrastructure* 3-7 November 2016 in Iasi, Romania. Commission 5 is preparing the *Cost Effective Positioning and Geo Data Seminar* with Commission 3 (Spatial Information Management) in conjunction with in Novosibirsk, Russia (20 April 2017).

### 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.

During 2016, the following FIG/IAG/ICG/NZIS/UN-GGIM-AP Technical Seminar on Reference Frame in Practice was held with sister organisations in Christchurch, New Zealand (1-2 May 2016).

#### **Report on FIG/IAG/ICG/NZIS/UN-GGIM-AP Technical Seminar on Reference Frame in Practice on 1-2 May 2016 in Christchurch, New Zealand**

The Technical Seminar on Reference Frames in Practice (RFIP) was held for the fourth time. The first Technical Seminar on RFIP was held in 2012 in Rome. This time it was held prior to the FIG Working Week on 1-2 May 2016 in Christchurch, New Zealand. There was a particular focus on deformation modelling and datum unification, which reflects geodetic priorities for the Asia-Pacific region. Many of the participants come from countries situated on the Pacific “ring of fire”, where there is a strong need to model deformation to maintain accurate spatial references. The theme of datum unification reflects the desire of Pacific Island nations, amongst others, to work more closely together to share knowledge and resources for their mutual benefit. This complemented a previous seminar, which was held in Singapore 2015 focused on vertical reference frames and the seminar in Manila in 2013, which focussed on 3D frames.

The workshop 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 New Zealand Institute of Surveyors (NZIS). Primary organisers were Nic Donnelly (New Zealand) and Li Zhang (Germany), both members of FIG Commission 5.

There were 53 participants, including presenters, from around the world. Countries represented were Australia, Bulgaria, Fiji, Germany, Indonesia, Japan, Nepal, Malaysia, New

Zealand, the Philippines, Poland, Russia, Singapore, Sweden and the United States. Attendees represented a mix of academic, government and commercial institutions.



*Group photo of attendees*

The seminar was well supported by all three sponsors, Land Information New Zealand, Leica and Trimble, in terms of both financial support and attendance. The ICG provided financial support to several participants from developing nations. The sponsorship enabled registration fees to be kept to a low level at 150 euro for the two days, including the dinner.

The final technical programme and the presentations are available on the FIG website at <http://www.fig.net/fig2016/commission5.htm>. Copies of the geodetic software discussed were included on memory sticks provided to each of the participants.

### 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 May in Christchurch (see 3.2). Additionally the UNOOSA ICG held its annual meeting on 6-11 November 2016 in Sochi, Russia. FIG Vice President (ex-Commission 5 chair) Mikael Lilje represented FIG at the meeting. A report can be found in [http://www.fig.net/news/news\\_2016/2016\\_11\\_icg.asp](http://www.fig.net/news/news_2016/2016_11_icg.asp).

Also the FIG/IAG/ICG/NZIS/UN-GGIM-AP Technical Seminar on Reference Frame in Practice on 1-2 May 2016 in Christchurch is a good example for UN-cooperation, here on the technical level. As mentioned before these Seminar series will be continued in the future.

Additionally at the FIG Working Week 2017 in Helsinki, a special technical session on the implementation plan connected to UN Resolution on Global Geodetic Reference Frame (GGRF) will be organised and will include presenters from the e.g. UN GGIM, IAG, IGS.

### 3.4 Cooperation with ISO

There has been ongoing interaction with ISO/TC211, the geographic information technical committee of ISO. Nic Donnelly is the Special Liaison from FIG to ISO/TC211. Work of particular interest to Commission 5 includes the review of ISO19111, spatial referencing by coordinates, the ongoing work on the Geodetic Registry and ISO19161, the proposed new standard for the International Terrestrial Reference System. The update to ISO1911 is focussed particularly on better accounting for kinematic frames (time-dependent coordinates) and geoid-based vertical datums. It is being revised in conjunction with the Open Geospatial Consortium (OGC), as is the case with many ISO standards, to ensure that the revised standard represents a wide industry view.

## **4. Events**

### **2016**

A summary of the Commission 5 activities at events in 2016 can be found on our website <http://www.fig.net/commission5/index.htm>

### **2017**

In 2017 Commission 5 will endeavour to send representatives to the following conferences:

- UAV-Seminar, 09-10 February 2017, Stuttgart, Germany
- GeoSiberia, 19-21 April 2017, Novosibirsk, Russia
- FIG Cost Effective Positioning and Geo Data Seminar, 20 April 2017, Novosibirsk, Russia
- FIG Working Week 2017, 28 May - 01 June, 2017, Helsinki, Finland
- UN-GGIM-AP/ IAG/FIG Technical Seminar on Vertical Reference Frames in Practice, 29-30 July in Kobe, Japan
- Special Session of FIG Commission 5 at Intergeo 2017, 26-28 September 2017, Berlin, Germany

## **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  
January 2017