

FIG Commission 5

Annual Report of Activities 2020

1. General

The onset of the COVID virus definitely reduced the volume of work accomplished in Commission 5. Nevertheless, significant accomplishments were completed that furthered the Commission 5 2019-2022 work plan. Engagement with UN-GGIM's UN-SCoG has intensified. In conjunction with the FIG Capacity Development Network and Commission 2, collaboration on opportunities for capacity development have flourished. This is particularly true with the UN-SCoG WG on Education, Training and Capacity Building. Presentations last year and this year focused on bringing various aspects of the UN-GGIM agenda in front of members of the FIG.

There is an ongoing collaboration with United Nations Agencies to address global problems such as sustainable development and humanitarian needs. The disciplines covered by Commission 5 will deliver solutions for the spatial aspects of these important global problems. Specific activities aimed at developing countries include examination of Low Cost Surveying Technologies, assistance with implementation of modern Geodetic and Vertical Reference Frames and associated infrastructure and contribution to appropriate Continuing Professional Development programs.

Additionally, Commission 5 continued to work closely with the International Association of Geodesy (IAG) and the United Nations Global Geospatial Information Management (UN GGIM) on the development of new models, standards and tools for implementing a Global Geodetic Reference Frame (GGRF) that includes aspects of the International Terrestrial Reference Frame (ITRF) and the International Height Reference Frame (IHRF). The GGRF will serve as a global standard for all Nations to implement their respective national datums. As such, this directly impacts FIG Members who must implement these new datums and the requirements to access them. Likewise, FIG has engaged with ISO TC211 to ensure that internationally recognized GIS standards are consistent with those for national reference frames utilized by FIG Member organizations.

Commission 5 also continued support to FIG Task Forces, the Standards Network, and regional Capacity Development Networks (e.g., AP CDN). The Commission will also respond to the FIG Council to address new issues as they emerge.

For 2020, Commission 5 supported efforts with FIG CDN to host a virtual *Technical Seminar on Reference Frame in Practice* on 10 December 2020 for Member states in the Asia-Pacific region (see below). The plan remains to hold a virtual RFIP seminar in conjunction with the SIRGAS 2021 meeting – though this will also need to be virtual. The next likely in-person RFIP seminars remain planned for the FIG Congress in 2022 in Cape Town and possibly during the SIRGAS 2022 meeting (location: TBD). Commission 5 also provided input to Commission 2 for a GIM International article covering presentations developed for FIG 2020. A summary of the working group activities in 2020 follows.

2. Working Groups

WG 5.1 – Standards, Quality Assurance and Calibration

Chaired by David Martin

Standards play an important role in surveying and particularly with modern instrumentation that give black box solutions and measurements that are not necessarily understood by the average practicing surveyor. Although surveyors are generally not directly implicated in standards and standardisation, they are implicitly very reliant upon standards underpinning the correct functioning of their instruments.

Working Group 5.1 actively participates in technical sessions, technical seminars and presentations for FIG Working Weeks and Congresses. Working Group 5.1 is also very closely linked to the FIG Standards Network and standards work of the other FIG Commissions (e.g. the Land Administration Domain Model being developed through Commissions 4,7,8 and 9. Importantly Working Group 5.1 is the contact for FIG liaison to the ISO Technical Commission (TC) 211 and Technical Committee ISO/TC 172/SC 6.

ISO TC 211 works on standardization of digital geographic information establishing a structured set of standards 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, analysing, accessing, presenting and transferring such data in digital/electronic form between different users, systems and locations. Nic Donnelly, from Land Information New Zealand, (also FIG Commission 5.2) is the FIG liaison to TC211.

ISO/TC 172/SC 6 deals more closely with surveying instruments. These standards deal with field procedures for testing geodetic and surveying instruments such as theodolites, total stations, levels, laser scanners and GNSS in real-time kinematic (RTK). Ingo Neumann from the Geodätisches Institut Leibniz Universität Hannover is the FIG representative to ISO/TC 172/SC 6.

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.

An article summing up standardisation activities in FIG was published in Geoconnection this year: Will We Become the New Romans, January/February 2021 International Issue Geoconnection Volume 20 - Issue 1 pp 20-22.

WG 5.2 – 3D Reference Frames

Chaired by Nic Donnelly

The main activity for Working Group 5.2 was the organisation of a short seminar on Reference Frames in Practice held online on 10 December 2020. This focussed on the Asia-Pacific region and was organised with the support of the FIG Asia-Pacific Capacity Development Network. The theme was *Progress and Challenges in the Asia-Pacific Region* and the seminar included presentations from Australia, Tonga, Fiji, Papua New Guinea, Philippines, New Zealand and

the Pacific Geospatial and Surveying Council. It was clear from the presentations that there is excellent progress on reference frame development being made in many countries. Ongoing challenges include capacity and capability development, the incorporation of deformation into reference frames, implementing vertical reference frames based on geoids and helping decision-makers understand the crucial role of the reference frame underpinning accurate positioning and data management. The co-conveners of the seminar were Nic Donnelly and Chris Pearson.

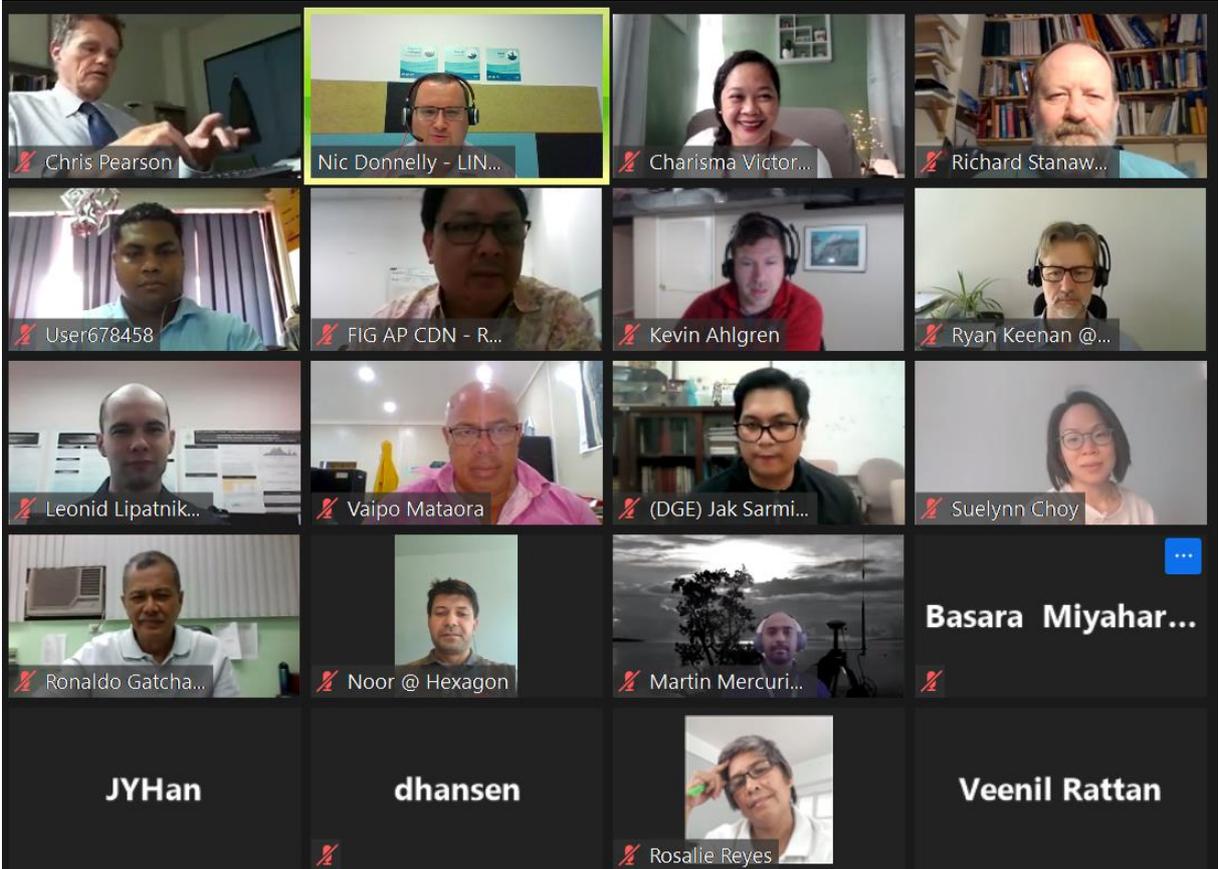


Figure: Participants in the Reference Frames in Practice Seminar held 10 December 2020

Working group members continue to be active in a number of relevant international groups. These include the OGC project teams working on the standardisation of a deformation model functional model and format as well as the IAG’s Working Group 1.3.1 on Time-dependent transformations between reference frames in deforming regions.

WG 5.3 – Vertical Reference Frames
 Chaired by David Avalos-Naranjo

The massive cancelation of events during 2020 included the workshop of Reference Frames in Practice. The participation on future versions of this workshop is being prepared to regain contact with the surveying community and ease the implementation of vertical reference frames. Future activities have been planned, like promoting the objectives of the working group at FIG regional congresses and the Working Week 2021.

Collaboration with the International Association of Geodesy has started with an aim to promote a guideline for IHRF first implementation in countries with traditional tidal datum.

WG 5.4 – GNSS

Chaired by Suelynn Choy and Ryan Keenan

The GNSS working group continues to support multi-constellation GNSS activities through in the UN International Committee on GNSS (UN ICG) with collaboration from the International GNSS Services (IGS), International Association of Geodesy (IAG) and Multi-GNSS Asia (MGA).

The global pandemic has affected every country, lives, and the activities within FIG. At the same time, the GNSS industry is adapting to the pandemic and helping to address some of challenges, e.g., in playing a role in controlling the virus, for positioning data acquisition, reporting of location information, distribution of relevant information, and for describing and analyzing the occurrence of outbreaks. In 2020-2021, FIG WG 5.4 is contributing and participating in the IAG General Assembly, ION GNSS+ online/hybrid conferences as well as various online webinar series on GNSS. WG 5.4 chairs welcome ideas and contributions from members of the FIG on ways to better engage and support our community in the post-COVID-19 world.

In terms of capacity building activities, FIG WG 5.4 have been actively involved in the ongoing efforts of the UN GGIM's Subcommittee on Geodesy (SCoG)'s Education, Training and Capacity Building (ETCB) working group. Following the WG ETCB presenting a paper at FIG WW 2020 on the results of a global Questionnaire around the perceived geodetic Reference Frame competency levels around the world, an updated global Questionnaire is set to be released in mid-2021 with greater focus on the regional competencies and needs. It is expected the new regional insights gathered will contribute significantly to the strategic activities planned by the UN GGIM Global Geodetic Centre of Excellence (GGCE).

Additionally, FIG WG 5.4's involvement in the work of ISO TC20/SC14/WG1 to review WD24246 - the development of a new standard for 'GNSS positioning augmentation centers' continues, with an expected publication near the end of 2021. With this new standard, it is expected that the dissemination of GNSS augmentation information from solution providers will be open, unambiguous and accessible to the growing user community.

In summary, FIG WG 5.4 is actively involved with those groups responsible for helping to define the future of GNSS positioning into the next decade, and beyond.

WG 5.5 – Multi-Sensor-Systems

Chaired by Allison Kealy and Günther Retscher (IAG)

WG efforts focus on processing techniques in three primary areas – firstly, more representative statistical error distributions for the non traditional sensors such as Wi-Fi and Ultra Wideband based on real-world data; secondly, the implementation of novel techniques such as differential Wi-Fi and information grammar as approaches to improving the positioning solution achievable

from traditional sensor fusion techniques and thirdly, robust, decentralised fusion algorithms for scalable and practical collaborative networks.

This WG undertook a follow up to the outreach program in Sri Lanka started in 2018. Working collaboratively with the Sabaragamuwa University (Geomatics Department), two workshops were conducted (July 2018 and July 2019) specifically with a knowledge transfer focus. A key aspect of these workshops was a data collection campaign to evaluate the performance of GAGAN and NavIC, the Indian contributions to GNSS. Since January 2021 Sabaragamuwa University is serving as Sri Lanka's National coordinating institution in a joint project under the lead of TU Wien funded by European Union's Erasmus+ Capacity Building in Higher Education programme entitled 'Curricula Enrichment delivered through the Application of Location-based Services to Intelligent Transport Systems / LBS2ITS'.

A further activity started in 2020 with an international measurement campaign of TU Wien, Ghent University and KU Leuven concerning an investigation of the suitability of Bluetooth RSSI measurements for covid-19 contact tracing:

<https://www.youtube.com/watch?v=x6y8W80qH8M>

Members of this WG are also very active in promoting the women in positioning, navigation and timing (PNT) activities underway in other professional associations such as the ION and RIN.

WG members participated in various capacities in the following conferences:

- ION GNSS+ 2020 conference (virtual),
- ION ITM 2021 (virtual),
- ISPRS, Nice (postponed).

WG 5.6 – Cost Effective Positioning

Chaired by Leonid A. Lipatnikov and Li Zhang

In 2020, WG continued its activities in educating associations and individual surveyors on when to use which surveying instrument or software taking into account economic reasons, supporting decision makers for establishing cost-effective positioning solutions, and designing fit-for-purpose surveying systems that are cost-effective.

WG members participated in the following conferences:

- DVW UAV 2020, February 2020, Hattingen, Germany;
- European Navigation Conference, November 2020, Online;
- Geo-Siberia, July 2020, Novosibirsk, Russia.

A number of R&D projects were elaborated by the WG 5.6 members in 2020. Among them:

- Low-Cost GNSS Equipment for Monitoring;
- Open Software & Hardware Inclinometer;
- Collaborative Precise Positioning Demonstrator;
- Low-Cost multisensor system for kinematic application.

The work on the 2nd edition of FIG report 74 "Cost effective precise positioning with GNSS" was under way. Compared to the previous one, the new edition will contain the latest updates on high-precision low-cost GNSS hardware, software-defined receivers, CORS networks, free data and information sources, versatile free open-source software, free online post-processing and real-time correction services, and SBAS. The recent events of 2020 including BeiDou reaching full operational capability, start of Starlink trials, fast growing number of dual-frequency smartphones, and their impact on cost and availability of high precision positioning will be covered in the report. Especial emphasis will be made on new opportunities for worldwide mass-market high-precision positioning services with seamless coverage.

The recent updates on those topics and the first results of the aforementioned R&D projects by WG members are planned to be discussed at the second Cost Effective Positioning Seminar which is to be held in December 2021 both online and offline in Novosibirsk, Russia.

3. Cooperation, Seminars and Workshops

3.1 Cooperation with Other Commissions

All the Commissions supported Commission 2's lead on developing an article for GIM International to capture much of the effort that had gone into planning for the FIG 2020 WW.

Other areas include:

- Commission 4 regarding Hydrographic Surveying on the Ellipsoid
- Commission 6 and ISPRS on Laser Scanning
- Commission 6 on UAV Usage for Surveying
- Commission 7 and 3 on Cost-Effective Positioning
- Regional Capacity Development efforts in Asia-Pacific, Africa, and the Americas

3.2 Cooperation with Sister Organisations

Commission 5 continued to maintain a successful working relationship with the International Association of Geodesy (IAG), PGSC (with AP CDN) and SIRGAS. 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 2020, a Technical Seminar on Reference Frame in Practice was held virtually for the Asia-Pacific region. See notes in the WG 5.2 for further details.

3.3 Cooperation with UN

FIG and IAG are both supporting the UN International Committee on GNSS (UN ICG) as well as the UN Global Geospatial Information Management (UN GGIM) Committee. The UN GGIM has implemented the Global Geodetic Reference Frame (UN GGRF) that is being

implemented by the UN GGIM SubCommittee on Geodesy (UN SCoG). The UN SCoG has several working groups including one on Education, Training and Capacity Building (WG ETCB). The FIG Leadership as well as Commissions 2 and 5 are working closely with ETCB to evaluate the geodetic and surveying capabilities of Nations and to catalog available training resources for surveyors around the world.

3.4 Cooperation with ISO

There has been ongoing interaction with ISO/TC211, the geographic information technical committee of ISO. Nic Donnelly continues as the Special Liaison from FIG to ISO/TC211. ISO TC211 has focused on maintaining and expanding the ISO Geodetic Registry to ensure all national and international reference frames and vertical datums are listed officially. This enables GIS and other programmers to accurately transform positions and measurements for FIG Members.

4. Events

2020

In 2020, Commission 5 supported::

- GIM International article from presentations created for the FIG Working Week 2020
- FIG Technical Seminar on Reference Frames in Practice in the Asia-Pacific region

2021

In 2021, Commission 5 plans to participate in

- The FIG virtual Working Week hosted by the Netherlands in June
 - Three Commission specific sessions
 - One joint session with Commission 4
 - Supporting the UN-GGIM specific meetings
- A virtual RFIP during a SIRGAS seminar in November
- A virtual Cost Effective Positioning Seminar in December

5. Communication and Publications

Commission 5 has 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>

**Daniel R. Roman,
Chair**

Chair of FIG Commission 5
June 2021