

FIG Commission 5 – Positioning and Measurement

Work Plan 2023-2026

1. Title

Positioning and Measurement

2. Terms of Reference

- The science of measurement (instrumentation, methodology and guidelines)
- The acquisition of accurate and reliable survey data related to the position, size and shape of natural and artificial features of the Earth and its environment and including their variations over time consistent with internationally adopted standards and models.

3. Mission Statement

Positioning and Measurement is at the core of the surveyor's profession and underpins FIG Council's Vision over the term 2023-2026: 'Serving society, benefitting people and the planet' and so enabling us to tackle the Global Challenges.

To support this vision, the mission of Commission 5 is to:

- Focus on modern technologies, and technical developments and assist individual surveyors, engineers and GIS/LIS professionals through guidelines and recommendations, to choose and utilise those methods, technologies and instruments that are most appropriate ('fit for purpose') to different applications.
- Follow technical developments and trends through collaboration with other FIG Commissions and other international organisations; participation in appropriate meetings; and the preparation of appropriate publications.
- Support research and development and stimulate new ideas in the fields of expertise represented within the Commission.
- Collaborate with manufacturers on the improvement of instrumentation and associated software.
- Present and promote the work of the Commission and its working groups on an on-going basis at FIG Congresses, FIG Working Weeks, FIG Regional Conferences and other relevant technical meetings and in appropriate FIG and other media.

4. General

This work plan covers the development, use and integration of technologies for positioning and measurement and the associated standardisation, best practice and fundamental reference frame issues. Complementing the FIG Council theme to tackle the global challenges, Commission 5 is well positioned and suited, along with many other Associations, to tackle the technological challenges we all face.

There will be ongoing cooperation 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 through its six working groups as follows.

- WG 1 – Standards, Quality Assurance and Calibration
- WG 2 – 3D Reference Frames
- WG 3 – Vertical Reference Frames
- WG 4 – GNSS
- WG 5 – Multi-Sensor Systems
- WG 6 – Cost-Effective Positioning

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.

Specifically, 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.

In addition to the specific activities above, the Commission will support and contribute to FIG Task Forces and the Standards Network. The Commission will also respond to the FIG Council to address new challenges around Planet, People, Partnerships and Governance & Communications.

5. Working Groups

Working Group 5.1 – Standards, Quality Assurance and Calibration

Policy Issues

- Influence the development of standards affecting positioning and measurement instruments and methods, in collaboration with the FIG Standards Network and through participation in the relevant technical committees (TCs) of the International Standards Organisation (ISO) and other appropriate bodies.
- Acceptance controls, quality assurance and certification and their impact on the surveying profession.
- Testing and calibration of measuring instruments.
- Assist other Commission Working Groups to implement Standards from TC 172/SC 6 and ISO TC211 as appropriate.

Chair

Dr. David Martin (France), e-mail: david.martin@esrf.fr

Specific projects

- Guide for the expression of uncertainty in measurements (GUM) for surveying
- Connection to ISO TC211 Geographic information/Geomatics and ISO TC172/SC6

Geodetic and surveying instruments

Workshops

- Participation in FIG Working Weeks and other major Commission events with dedicated Technical Sessions and/or Workshops as appropriate.
- Special Session on ISO TC211 at a FIG Working Week.
- Sessions dedicated to the Standard for Surveying by Drones initiative.

Publications

- A dedicated publication regarding the implementation of the “Guide for the expression of uncertainty in measurements” (GUM) for Surveying.
- A draft of a Standard for Surveying by Drones; the exact form of the standard (FIG document, ad how or ISO TC211) will be decided later.

Timetable

- Draft publications will be presented at FIG Working Weeks during the term of this plan and according to a timetable to be developed by the Working Group Chairs.
- Working Group’s final report and outcomes will be presented at a dedicated session at the FIG Congress 2026.

Beneficiaries

FIG member associations, manufacturers and users of survey equipment, governments, standardisation organisations, decision makers, GIS developers and users, surveying businesses, individual surveyors.

Working Group 5.2 – 3D Reference Frames

Policy Issues

- Work to bring together all organisations involved in defining or using reference frames to develop common approaches and avoid duplication. Such organisations include FIG, the International Association of Geodesy (IAG), UN-GGIM, ISO, groups of national mapping agencies, and other influential national agencies.
- Continue the existing co-operation with IAG on the Regional Reference Frame Projects such as AFREF, APREF, EUREF, NAREF, and SIRGAS.
- Develop and expand upon the relationships with UN-GGIM’s Sub-Committee on Geodesy (UN SCOG), its various Working Groups, and the various UN-GGIM regional bodies.
- Consider options for the development and implementation of 4-dimensional datums that incorporate the effects of plate tectonic and regional effects such as those due to earthquakes, as well as local effects such as landslides.
- Provide background technical information on relevant issues written in a way that is accessible to surveying practitioners.
- Examine how surveying practitioners can more easily access the reference frame, with less emphasis on networks of ground monuments and more emphasis on Global Navigation Satellite Systems (GNSS) base stations.
- Provide information on the maintenance of CORS networks to ensure long-term stability.

Chair

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Co-chair

Dr. Chris Pearson (New Zealand), e-mail: chris_pearson2@trimble.com

Specific projects

- Review of current Reference Frames in Practise Manual
 - o Continued development of current resources
 - o Support from WG 5.3 and others as required for all sections
- Connection to ISO-TC211: Geodetic Registry Network.

Workshops

- Continuing Seminars on Reference Frames in Practise, 3D and vertical frames
- Participation in FIG Working Weeks and other major Commission events with dedicated Technical Sessions.
- An RFIP Workshop will be held in conjunction with the main FIG events in this term, namely FIG WW2023 in Orlando, FIG WW2024 in Accra, FIG WW2025 in Brisbane and FIG Congress 2026 in Cape Town. We also hope to hold another RFIP seminar associated with an appropriate SIRGAS and a Pacific Geomatics Surveying Council meeting in the South Pacific Symposium depending on funding. These seminars contribute to the People, Partnerships, Governance & Communications focus areas. In particular the opportunity to connect with colleagues in the Caribbean, Africa and FIG and the Pacific Island developing states. We would also like to look for other sources of funding to augment travel funding provided by UNOOSA so we can offer more support to our colleagues in the developing world.
- In addition to the RFIP workshops and seminars, we would like to be proactive in developing ties to the South Pacific by working with Survey and Spatial NZ to implement the existing MOU with the Pacific Geomatics and Survey Council (PGSC).

Publications

- FIG Publication on ITRF
- Publication regarding national datums (different types)

Timetable

- Draft publications will be presented at FIG Working Weeks during the term of this plan and according to a timetable to be developed by the Working Group Chairs.
- Working Group's final report and outcomes will be presented at a dedicated session, FIG Congress, 2026.

Working Group 5.3 – Vertical Reference Frames

Policy Issues

- Inform FIG member agencies on current and future status of regional and global vertical reference frames, height systems and dynamics of the gravity field and geoid.
- Educate FIG member agencies on practical aspects about the implementation of new geopotential datums including:
 - o access using geoid height models and a geometric datum;
 - o redefining heights on existing bench marks to serve as secondary control;
 - o link between height systems, local and IHRF

- Develop and expand relationships in IAG Commission 2, UN SCOG, and working groups focused on implementing the International Heights Reference Frame (IHRF) and the International Terrestrial Gravity Reference Frame (ITGRF):
 - o IAG develops the IHRF and ITGRF;
 - o UN GGIM encompasses IHRF, ITGRF and ITRF as fundamental components of the Global Geodetic Reference Frame (GGRF);

Chair

Dr. David Avalos-Naranjo (Mexico), e-mail: david.avalos@inegi.org.mx

Co-chair

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Specific projects

- Promotion of the ISO-TC211: Geodetic Registry Network.
- Connection to IAG, Commission 2 to develop a guideline to interpret and access the IHRF for local and national vertical control.

Workshops

- Special VRF sessions at FIG Working Weeks.
- Vertical space inside the Reference Frame in Practice seminars.

Publications

- FIG publication on practical aspects of using modern vertical reference frames and height systems.

Timetable

- 2023: general design of an FIG publication on VRF and making connections to IAG and within FIG people to make a list of authors. Support and participation to the WW in the US.
- 2024: produce a draft version of the publication. Support and participation to the WW in Ghana.
- 2025: submission of a definitive document for revision and publication. Support and participation to the WW in Australia.
- 2026: an end of term report is to be presented at the FIG Congress.

Beneficiaries

FIG member associations, government agencies, decision makers, GIS developers and users, surveying businesses, individual surveyors.

Working Group 5.4 – GNSS

Policy Issues

- Examine the positioning services using terrestrial and space-based augmentation techniques.
- Research and dissemination regarding real-time networks, multi-GNSS products and advancements.
- Support and examine emerging positioning dissemination standards such as 3GPP.
- Advancements in Low Earth Orbit (LEO) PNT technologies and their integration with GNSS.
- Research into resilient PNT.
- Provide FIG input during planning and implementation phases associated with programs of modernisation and development of all GNSS.

Chair

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Co-Chair

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Specific projects

- Research and Publications on “Precise Point Positioning, Network RTK, Processing Services, Low-Cost GNSS, Multi-GNSS”.
- Research into emerging technologies such as LEO PNT, 5G and others.
- Outreach of GNSS applications to other organisations.
 - Involvement with regional GNSS training schools (e.g. UNOOSA,)
 - Other more industry driven groups (e.g. Precision Agriculture, Environment, Space, ITS etc), especially where they are related to some of the UN SDGs, which would leverage UN-GGIM and UN-GGRF activities.
 - FIG has a seat as co-chair along with IAG and IGS on UN-ICG leading WG-D on Reference Frames, Timing and Applications. An annual report is generated for FIG.

Workshops

- Continuing Seminars on Reference Frames in Practise, 3D and vertical frames
- Special Session regarding these topics on FIG Working Weeks and Conferences.

Publications

A number of papers will be published covering:

- Multi-GNSS advances including best-practise examples;
- Cost-effective high-precision positioning for mass-markets (together with WG5.6).

Timetable

- Draft publications will be presented at FIG Working Weeks during the term of this plan and according to a timetable to be developed by the Working Group chairs.
- Working Group’s final report and outcomes will be presented at a dedicated session, FIG Congress, 2026.

Beneficiaries

FIG member associations, government agencies, decision makers, GIS developers and users, surveying businesses, individual surveyors.

Working Group 5.5 – Multi-Sensor Systems (joint with IAG)

Policy Issues

This group is a joint working group between FIG and IAG. It oversees 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.

Chair

Prof. Guenther Retscher (Austria), e-mail: Guenther.Retscher@geo.tuwien.ac.at

Specific project(s)

- International field experiments and workshops on a range of multi sensor systems and technologies.
- Evaluation of UAV capabilities and the increasing role of multi-sensor systems in UAV navigation.
- Investigate the role of vision based measurements in improving the navigation performance of multi-sensor systems.
- Development of shared resources to encourage rapid research and advancements internationally.

Workshops

Special Sessions at Working Weeks and Supporting Special international conferences and symposia including: Mobile Mapping Symposium, ION GNSS+, IGNSS Australia, IPIN, etc.

Publications

A number of papers will be submitted to relevant conferences and technical journals.

Timetable

- Draft publications will be presented at FIG Working Weeks during the term of this plan and according to a timetable to be developed by the Working Group Chairs.
- Working Group's final report and outcomes will be presented at a dedicated session, FIG Congress, 2026.

Beneficiaries

FIG member associations, academic and research institutions, spatial data acquisition specialists, third party developers of LBS (location based services) requiring mobile location information, GIS developers and users, surveying businesses, individual surveyors.

Working Group 5.6 – Cost Effective Positioning

Policy issues

- Educate FIG member associations and individual surveyors on when to use which surveying instrument or evaluation software taking into account economic reasons.
- Introduction of cost effective tools (software and hardware) to make fit-for-purpose surveying systems more accessible in developing countries for sustainable development
- Support decision makers for establishing cost-effective positioning solutions.
- Review and evaluate accuracy, reliability and robustness of cost effective solutions.
- Evaluate optimisation of algorithms used for processing sensor data, power consumption and calculating the sensor position.

Chair

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Co-Chair

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Specific project(s)

Developing guidelines for cost-effective use and design of survey solutions including costs for labour and investment.

Workshops

- Special technical Sessions regarding cost-effective positioning during the FIG Working Weeks.
- FIG Workshop with Commissions 3 and 7.

Publications

FIG Publication on Cost-effective Surveying Techniques (with support from WG5.4).

Timetable

- Working Group final report and outcomes will be presented at a dedicated session, FIG Congress, 2026.

Beneficiaries

FIG member associations, academic and research institutions, spatial data acquisition specialists, GIS developers and users, surveying businesses, individual surveyors mainly dedicated to developing countries.

6. Co-operation with Other Commissions, Networks and Organisations

- Commission 2 and YSN regarding Education, Training and Capacity Building;
- Commission 4 regarding Hydrographic Surveying on the Ellipsoid;
- Commission 6 on Deformation Monitoring;
- Commission 7 and 3 on Cost-Effective Positioning;
- Asia-Pacific Capability Development Network (FIG AP CDN);
- Planned Commission 5 Special Issue in The Survey Review journal.

7. Co-operation with United Nation Organisations, Sister Associations and other Partners

- United Nations Office for Outer Space Affairs (UNOOSA) and United Nations International Committee on GNSS (UN-ICG). FIG Commission 5 is represented on the UN-ICG.
- UN GGIM is another field of cooperation between UN and FIG Commission 5, specifically the UN Sub-Committee on Geodesy (UN SCOG) and the regional UN-GGIM groups (i.e., UN-GGIM-AP).
 - UN SCOG has a number of working groups that have closely aligned interests such as the WG for Education, Training and Capacity Building (ETCB).
 - The regional groups usually have a WG aligned to implementing regional Geodetic Reference Frames (EUREF, SIRGAS, APREF) that directly impact the work of FIG Member institutions.
 - The UN-GGIM Academic Network also provides a link to academic organizations aligned to ETCB, and the UN-GGIM Private Sector Network focusses on small and medium enterprises from private industry.
 - The new UN-GGIM Global Geodetic Centre of Excellence (GGCE) has been established to, and Commission 5 has been invited to contribute through its inaugural International Advisory Committee (ISC).
 - Commission 5 members are active in all of the above groups.
- Strong Cooperation with International Association of Geodesy (IAG), with which FIG has a Memorandum of Understanding; Working Group 5.5 is jointly organized with IAG.
- Strong Cooperation with International GNSS Service (IGS), with Commission 5 invited as FIG Representative to IGS Governing Board.
- Good cooperation with International Society for Photogrammetry and Remote Sensing (ISPRS), the Permanent Committee on GIS Infrastructure Asia Pacific (PCGIAP) and the US based Institute of Navigation (ION).
- Contribution to International Standard Organizations, especially ISO TC 211/AWG12 and TC 172/SC6.

8. Commission Officers

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