Commission 4 - Positioning & Applications

web: www.gmat.unsw.edu/iag/iag_comm4.htm

President: **Chris Rizos** (Australia)
Vice President: **Pascal Willis** (France)

Terms of Reference

To promote research into the development of a number of geodetic tools that have practical applications to engineering and mapping. The Commission will carry out its work in close cooperation with the IAG Services and other IAG Entities, as well as via linkages with relevant Entities within Scientific and Professional Sister Organizations. Recognizing the central role that Global Navigation Satellite Systems (GNSS) plays in many of these applications, the Commission's work will focus on several Global Positioning System (GPS)-based techniques. These include precise positioning, but extending beyond the applications of reference frame densification and geodynamics, to address the demands of precise, real-time positioning of moving platforms. Several Sub-Commissions will deal with precise kinematic GPS positioning technology itself (alone or in combination with other positioning sensors) as well as its applications in surveying and engineering. Recognizing the role of continuously operating GPS reference station network, research into non-positioning applications of such geodetic infrastructure will also be pursued, such as atmospheric sounding.

Steering Committee

President: Chris Rizos (c.rizos@unsw.edu.au)
Vice President: Pascal Willis (Liaison with IGGOS)
Chair SC4.1: Dorota Grejner-Brzezinska
Chair SC4.2: Heribert Kahmen
Chairs SC4.3: Susan Skone, Hans van der Marel
Chair SC4.4: Xiaoli Ding
Chair SC4.5: Yang Gao
IGS representative: Ruth Neilan
Member at Large: Marcelo Santos (Liaison with ICCT)
Member at Large: TBA, Service representatives

Structure

Sub-Commissions:

SC4.1: Multi-sensor Systems
President: **D. Grejner-Brzezinska** (USA)

SC4.2: Applications of Geodesy in Engineering
President: **Heribert Kahmen** (Austria)

SC4.3: GNSS Measurement of the Atmosphere
President: **Susan Skone** (Canada)

SC4.4: Applications of Satellite & Airborne Imaging Systems
President: **Xiaoli Ding** (Hong Kong)

SC4.5: Next Generation RTK
President: **Yang Gao** (Canada)

Study Groups:

SG4.1: Pseudolite Applications in Positioning & Navigation
Chair: **Dr. Jinling Wang** (Australia)

Inter Commission Study Groups

IC-SG4.2: Statistics & Geometry in Mixed Integer Linear Models, with Applications to GPS & InSAR
(Joint with ICCT)
Chair: **Athanasios Dermanis** (Greece)

IC-SG1.1: Ionospheric Modelling and Analysis
(Joint with Commission 1 & COSPAR)
(Description: See commission 1)
Chair: **Claudio Brunini** (Argentina)

IC-SG1.2: Use of GNSS for Reference Frames
(Joint with Commission 1)
(Description: See commission 1)
Chair: **Robert Weber** (Austria)

Sub-Commission

SC 4.1 - Multi-sensor Systems

President: **Dorota Grejner-Brzezinska** (USA)
Vice President: **Naser El-Sheimy** (Canada)

Terms of Reference

To coordinate research and other activities that address the broader areas of multi-sensor system theory and applications, with a special emphasis on integrated guidance, navigation, positioning and orientation of airborne and land-based platform. The primary sensors of interest will be Global Navigation Satellite Systems (GNSS) and inertial navigation systems; however the important role of other techniques used for indoor and pedestrian navigation is also recognized. The SC will carry out its work in close cooperation with other IAG Entities, as well as via linkages with relevant scientific and professional organizations such as ISPRS, FIG, IEEE, ION.

Objectives

- To follow the technical advances in navigation sensors and algorithms, including autonomous vehicle navigation, based on:
    - positioning sensors and techniques such as GPS (and pseudoliltes), INS, including MEMS IMU, wheel sensors, ultrasonic and magnetic sensors, and
    - positioning methods based on cellular networks and their combination with GPS.
- To follow the technical advances in mapping sensors, such as CCD cameras, laser range finders, laser scanners and radar devices.
- To standardize definitions and measurements of sensor-related parameters.
- To study and report on the performance of standalone and integrated navigation systems.
- To stimulate new ideas and innovation in:
    - navigation algorithms, sensor calibration, synchronisation and inter-calibration,
    - real-time sensor information processing and georeferencing
    - sensor and data fusion, and
    - automation techniques for information extraction from multi-sensor systems using expert systems.
- To study and monitor the progress in new applications (not limited to conventional mapping) of multi-sensor systems (transportation, engineering, car navigation, personal navigation, indoor navigation, etc.).
- To study and report on the progress in performance, market availability and pricing of multi-sensor mapping systems and their hardware and software components.
- To promote research and collaboration with countries with no or limited access to modern multi-sensor technology.

Program of Activities

- To stimulate new ideas and innovation in:To study the technology and applications of multi-sensor systems in order to address the objectives for SC4.1 (see above).
- To report on the progress in research, performance, market availability, etc., of multi-sensor mapping systems in various ways, including seminars, position papers and via the SC4.1 web page.
- To organize and to participate in professional workshops, seminars, meetings, etc.
- To establish a web page providing information on SC4.1 activities, technology updates, professional meeting calendar, etc.

Steering Committee

President: Dorota Grejner-Brzezinska (OSU, USA)
Vice President: Naser El-Sheimy (U. of Calgary, Canada)
Secretary: Jinling Wang (UNSW, Australia)
Member-at-Large: Guenther Retscher (Vienna Univ. of Technology, Austria)
Joao Fernando Silva (UNESP, Brazil)

Membership

Dr. C. Glennie (Canada)
Prof. K.P. Schwarz (Canada)
Prof. A. Gruen (Switzerland)
Prof. B. Merminod (Switzerland)
Dr. G. Retscher (Austria)
Mr. L. Hothem (USA)
Prof. D. Li (China)
Dr. R. Li (USA)
Mr. H. Sternberg (Germany)
Dr. D. Grejner-Brzezinska (USA)
Dr. Y.D. Huang (UK)
Prof. A. Vettore (Italy)
Lt. S. Puntavungkour (Thailand)
Dr. H.G. Maas (The Netherlands)

Prof. S. Sugimoto (Japan)
Dr. V. Tao (Canada)
Dr. A. El-Mowafy (UAE)
Dr. Y. Hammada (Canada)
Dr. J. Skaloud (Switzerland)
Dr. M. Aziz, (Kuwait)
Mr. M. Cramer (Germany)
Dr. J. Kwon (Korea)
Dr. S. Nassar (Canada)
Dr. N. El-Sheimy (Canada)
Dr. J. Wang (Australia)
J.F.C. da Silva (Brazil)

Working Groups

WG: 4.1.1 Advances in inertial Navigation and Error Modelling Algorithms

Chair: Sameh Nassar (University of Calgary, Canada)
Co- Chair: Jay Kwon (Sejgon University, Korea)

Terms of Reference

To study and report the performance of the currently used inertial error modeling algorithms, and to promote the development of new methods and techniques for modelling inertial sensor errors. To implement innovative ideas for processing inertial data and integrating inertial systems with other sensors. To report the advances in the development of new inertial sensor technologies.

WG: 4.1.2 Indoor and Pedestrian Navigation

Chair: Guenther Retscher (Vienna Univ. of Technology, Austria)
Co-Chair: Bertrand Merminod (Swiss Federal Institute of Technology, Switzerland;

Terms of Reference

To promote research and development in the area of indoor and pedestrian navigation using multi-sensor integrated systems, based on medium to low-accuracy small-sized inertial systems, including micro-electro-mechanical systems (MEMS), and other positioning sensors, such as wheel sensors, ultrasonic and magnetic sensors, integrated with imaging sensors. To report progress on positioning methods based on cellular networks and their combination with GPS.

WG: 4.1.3 Advances in MEMS Technology and Applications

Chair: Mikel Miller (Sensors Directorate, Wright Patterson Air Force Base, USA)
Co- Chair: Jan Scaloud (Swiss Federal Institute of Technology, Switzerland)

Terms of Reference

To promote research into the development and integration of micro-electro-mechanical systems (MEMS) based inertial measurement units (IMU) that have practical applications to engineering and mapping. To promote research and development into precise, low-cost, low-power, small-sized, and high reliability IMU's for integration with other position, navigation, attitude, and time systems.

Sub-Commission

SC 4.2 - Applications of Geodesy in Engineering

President: **Heribert Kahmen** (Austria)
Vice President: **Gethin Roberts** (UK)

Terms of Reference

Rapid developments in engineering, microelectronics and the computer sciences have greatly changed both instrumentation and methodology in *engineering geodesy*. To build higher and longer, on the other hand, have been key challenges for engineers and scientists since ancient times. Now, and for the foreseeable future, engineers confront the limits of size, not merely to set records, but to meet the real needs of society minimising negative environmental impact. Highly developed engineering geodesy techniques are needed to meet these challenges. The SC will therefore endevour to coordinate research and other activities that address the broad areas of the theory and applications of engineering geodesy tools. The tools range from conventional terrestrial measurement and alignment technology (optical, RF, etc.), Global Navigation Satellite Systems (GNSS), geotechnical instrumentation, and software systems such as GIS, decision support systems, etc. The applications range from construction engineering and structural monitoring, to natural phenomena such as landslides and ground subsidence that have a local effect on structures and community infrastructure. The SC will carry out its work in close cooperation with other IAG Entities, as well as via linkages with relevant scientific and professional organizations such as ISPRS, FIG, IEEE, ION.

Objectives

- To monitor research and development into new technologies that are applicable to the general field of "engineering geodesy", including hardware, software and analysis techniques.
- To study advances in dynamic monitoring and data evaluation systems for buildings and other manmade structures.
- To study advances in monitoring and alert systems for local geodynamic processes, such as landslides, ground subsidence, etc.
- To study advances in geodetic methods used on large construction sites.
- To study advances in the application of knowledge-based systems in engineering geodesy.
- To document the body of knowledge in this field, and to present this knowledge in a consistent frame work at symposia and workshops.
- Through the SC4.2 Working Groups to promote research into several new technology areas or applications.

Program of Activities

- To study the technology and applications of engineering geodesy in order to address the objectives for SC4.2 (see above).
- To organize and to participate in professional workshops, seminars, meetings, etc.
- To establish a web page providing information on SC4.2 activities, professional meeting calendar, etc.

Steering Committee

President: Heribert Kahmen (Austria)
Vice President: Gethin Roberts (UK)
Secretary: Guenther Retscher (Austria)
Member-at-Large: Wolfgang Niemeier (Germany)

Working Groups

WG: 4.2.1 Measurement Systems for the Navigation of Construction Processes

Chair: Wolfgang Niemeier (Germany)
Co-Chair: Guenther Retscher (Austria)

Terms of Reference
To study and report the performance of the currently used navigation/guidance systems for construction machinery, and to promote the development of new methods and techniques for controlling construction processes.

WG: 4.2.2 Dynamic Monitoring of Buildings

Chair: Matthew Tait (Canada)
Co-Chair: Gethin Roberts (UK)

Terms of Reference
To study and report the performance of currently used building monitoring systems, including techniques based satellite and terrestrial measurements, and to promote new the application of new sensor technology.

WG: 4.2.3 Application of Knowledge-based Systems in Engineering Geodesy

Chair: Klaus Chmelina (Austria)

Terms of Reference

To study and report on topics such as control of measurement- and guidance-systems, deformation analysis, control of alert systems, and the evaluation of their complex data stream through the use of knowledge-based systems. To implement new research outcomes in Artificial Intelligence for deformation analysis and measurement system control.

WG: 4.2.4 Monitoring of Landslides and System Analysis

Chair: Gyula Mentes (Hungary)
Co-Chair: Zhenglu Zhang (China)

Terms of Reference:

Worldwide landslides are one of the major types of natural hazards, killing or maiming many people, and causing considerable damage to infrastructure. There has already been done a wide range of research work on landslides. Most of this work had a bias toward one discipline, such as remote sensing or geology. The proposal of the WG is to promote multi-disciplinary integration of different methods. The main goal is to establish an integrated workflow for landslide hazard management.

Sub-Commission

SC 4.3 -GNSS Measurement of the Atmosphere

President: **Susan Skone** (Canada)
Vice President: **Hans van der Marel** (The Netherlands)

Terms of Reference

Over the past decade, significant advances in GPS technology have enabled the use of GPS as an atmospheric remote sensing tool. With the growing global infrastructure of GPS reference stations, the capability exists to derive high-resolution estimates of total electron content and precipitable water vapour in near real-time. Recent advances in topographic modelling and the availability of space borne Global Positioning System (GPS) observations has also allowed 3-D profiling of electron density and atmospheric refractivity. Future plans for the GALILEO system will allow further opportunities for exploiting Global Navigation Satellite Systems (GNSS) as an atmospheric remote sensing tool. Many countries have initiated efforts in this area of research and application. The focus of this Sub-Commission is to facilitate collaboration and communication, and support joint research efforts, for GNSS measurement of the atmosphere. Specific objectives will be achieved through the formation of appropriate Working Group. A Steering Committee will work closely with members and other IAG Commissions/Sub-Commissions to achieve mutual goals. Collaboration with the International GPS Service (IGS), the SG1.1, and other IAG entities and agencies will be promoted through, for example, joint sponsorship of workshops and conference sessions.

Objectives

This Sub-Commission will focus on the following principal objectives:

- To promote improvement of existing estimation algorithms and (near) real-time processing for atmospheric parameter monitoring using GNSS techniques, from both ground-based and space borne systems.
- To coordinate data collection campaigns, in order to encourage research and development into the measurement of crucial parameters of the atmosphere that impact on GNSS measurements.
- To investigate applications in both the atmospheric and space sciences.

Program of Activities

- To monitor research activities and operational developments in GNSS-based atmospheric parameter measurement related to the objectives for SC4.3 (see above).
- To report on the progress in research, performance, applications, etc., of atmospheric remote sensing using GNSS technology, including seminars, position papers and via the SC4.3 web page.
- To organize and to participate in professional workshops, seminars, data collection campaigns, meetings, etc.
- To establish a web page providing information on SC4.3 activities, technology updates, professional meeting calendar, etc.

Steering Committee

President: Susan Skone (Canada)
Vice President: Hans van der Marel (The Netherlands)
Members-at-Large: Anthea Coster (USA)

Sub-Commission

SC 4.4 -Applications of Satellite & Airborne Imaging Systems

President: **Xiaoli Ding** (Hong Kong)
Vice President: **Linlin Ge** (Australia)

Terms of Reference

Satellite and airborne imaging systems, primarily Synthetic Aperture Radar (SAR) and Light Detection And Ranging (LiDAR) systems, are increasingly being used for geodetic applications such as ground deformation monitoring due to seismic and volcanic activity and man-induced subsidence due to fluid extraction, underground mining, etc. This Sub-commission will endevour to promote and report on hardware/software research into these imaging systems that is relevant to geodetic applications. The SC will also facilitate communications and exchange of data, information and research results, in order to encourage wider application of these technologies, particularly in less developed countries. The SC will carry out its work in close cooperation with other IAG Entities, as well as via linkages with relevant scientific and professional organisations such as ISPRS, FIG, IEEE.

Objectives

- To promote the development of satellite and airborne imaging systems, primarily including Synthetic Aperture Radar (SAR) and Light Detection And Ranging (LiDAR) systems, for geodetic applications.
- To study and report on models and algorithms for the processing and analysis of data from satellite and airborne imaging systems.
- To promote research into the effects of the atmosphere and field conditions on satellite and airborne imaging systems.
- To encourage research and development into the integration of satellite and airborne imaging systems with other geodetic/geospatial technologies such as the Global Positioning System (GPS) and Geographic Information Systems (GIS).
- To promote the development of new applications of satellite and airborne imaging systems.
- To encourage lower SAR image prices for research purposes, and for use in less developed countries.

Program of Activities

- To monitor research activities and operational developments in satellite and airborne imaging systems such as InSAR and LiDAR as related to the objectives for SC4.4 (see above).
- To report on the progress in research, performance, geodetic applications, etc., of InSAR and LiDAR, including seminars, position papers and via the SC4.4 web page.
- To organize and to participate in professional workshops, seminars, campaigns, meetings, etc.
- To establish a web page providing information on SC4.4 activities, technology updates, professional meeting calendar, etc.

Steering Committee

President: Xiaoli Ding (Hong Kong)
Vice President: Linlin Ge (Australia)
Secretary: Makoto Omura (Japan)
Member-at-Large: Ramon F. Hanssen (The Netherlands)

Working Groups

WG: 4.4.1 Permanent Scatterer/ Corner Reflector/ Transponder InSAR

Chair: Fabio Rocca (Italy)
Co-Chair: Chao Wang (China)

Terms of Reference
To study and report on the use of permanent scatters, corner reflectors and active transponders to enhance the quality and the scope of applicability of InSAR.

WG: 4.4.2 Atmospheric Effects in InSAR/ InSAR Meteorology

Chair: Linlin Ge (UNSW, Australia)

Terms of Reference
To characterise the spatial and temporal variations of atmospheric effects on InSAR and LiDAR measurements, and to study methods for the mitigation of the effects.

WG: 4.4.3 InSAR for Polar Regions

Chair: Makoto Omura (Japan)

Terms of Reference
To study and report on the dynamic processes of the earth's polar regions, including the changes in the extent, thickness, and dynamics of ice shelves, ice streams and glaciers in Antarctica, and in Arctic sea ice and permafrost with satellite radar systems.

WG: 4.4.4 Imaging Systems for Ground Subsidence Monitoring

Chair: Andrew Manu (USA)

Terms of Reference
To study and report on ground surface deformation monitoring using satellite and airborne imaging systems, especially ground subsidence associated with, e.g., city development, mining and ground liquid withdrawal, land reclamation and seismic activities.

Sub-Commission

SC 4.5 - Next Generation RTK

President: **Yang Gao** (Canada)
Vice President: **Lambert Wanninger** (Germany)

Terms of Reference

Current carrier phase-based Real-Time Kinematic (RTK) positioning at the centimetre accuracy level requires the combination of observations from two GPS receivers, with one serving as the base station with known coordinates and another as the mobile/user station. One significant drawback for this approach, however, is the practical constraints imposed by the requirement that simultaneous observations be made at the user and reference stations, and that the user station be within the vicinity of the reference station typically up to 20 kilometers. Development of methods and algorithms to eliminate such constraints for increased flexibility and accessibility using RTK therefore presents a current trend. This Sub-Commission will identify, encourage investigation into the important research issues and problems for the development of next generation RTK technologies, report on such developments, and will promote international collaborations among researchers and organizations from academia, government and private sectors. The latter will be done through linkages with sister scientific and professional organizations, and especially with the IAG's International GPS Service (IGS).

Objectives

The objective of the Sub-Commission is to promote collective research efforts on the development of new methods and technologies for next generation RTK and to stimulate strong research collaborations among international organizations, including the industry. The main objectives of SC4.5 will be:

- To identify and investigate important technical issues in next generation RTK system development.
- To investigate and develop data standards and operational procedures for next generation RTK, including the communication protocols and message formats.
- To establish collaborative relationship with other organizations, and especially with the IGS.
- To develop strong links with the industry sector.
- To participate and organize international conferences, workshops and meetings.

Program of Activities

- To monitor research activities and operational developments in real-time GNSS positioning, both for "precise point positioning" and network-based modes as related to the objectives for SC4.5 (see above).
- To report on the progress in research, performance, etc., of next generation RTK, including seminars, position papers and via the SC4.5 web page.
- To focus on the development of standardized terminology for the various RTK systems, and to promulgate relevant standards such as those produced by RTCM, IGS, etc.
- To organize and to participate in professional workshops, seminars, meetings, etc.
- To establish a web page providing information on SC4.5 activities, technology updates, professional meeting calendar, etc.

Steering Committee

President: Yang Gao (Canada)
Vice President: Lambert Wanninger (Germany)
Secretary: Wu Chen (Hong Kong)
Member-at-Large: Mark Caissy (Canada)
Member-at-Large: John Raquet (USA)
Member: Sunil Bisnath (USA)

Membership

Mr. M. Caissy (Canada)
Prof. N. El-Sheimy (Canada)
Prof. J. Raquet (USA)
Mr. R. Muellerschoen (USA)
Dr L. Fortes (Brazil)
Prof. R. Langley (Canada)
Prof. R. Santerre (Canada)
Dr. P. Park (South Korea)
Prof. J. Liu (China)
Prof. T. Moore (UK)
Prof. M. Yang (Taiwan)
Prof. P. Cross (UK)
Prof. C. Rizos (Australia)
Prof. W. Chen (Hong Kong)
Dr. D. Kim (Canada)
Prof. R. Weber (Austria)
Prof. Y. Gao (Canada)
Mr. R. Hatch (USA)
Dr. S. Han (USA)
Mr. B. Townsend (Canada)
Dr. D. Lapucha (USA)
Dr. H. Landau (Germany)
Mr. P. Heroux (Canada)
Dr. H. Euler (Switzerland)
Dr. L. Wanninger (Germany)
Mr. J. Manning (Australia)
Dr. G. Weber (Germany)
Dr. J. Monico (Brazil)
Dr. D. Grejner-Brzezinska (USA)
Dr. P. Wielgosz (USA)
Dr. I. Kashani (USA)
Mr. P. Alves, (Canada)

Working Groups

WG: 4.5.1 Network RTK

Chair: Lambert Wanninger (Germany)
Co-Chair: Ola Ovstedal (Norway)

Terms of Reference
To study the various technical aspects of network RTK positioning and to stimulate further research work in this field. To report progress on the development of GNSS reference station networks for RTK positioning.

WG: 4.5.2 Carrier Phase based Precise Point Positioning

Chair: Sunil Bisnath (USA)
Co-Chair: Maxim Kachine (The Netherlands)

Terms of Reference
To address and investigate issues and problems related to the development of a new RTK positioning technology based on the processing of un-differenced carrier phase (and pseudo-range) observations without the need of a reference station.

WG: 4.5.3 High Precision Positioning on Buoys and Moving Platforms

Chair: Wu Chen (Hong Kong)
Co-Chair: Mark Dumville (UK)

Terms of Reference
To study precise positioning in marine environment including precise positioning algorithms on moving platforms, multipath effects off water surfaces, and data fusion of GNSS and other ocean environment sensors. To promote the collaboration of researchers from different research areas, including geodesy, navigation, oceanography, and meteorology.

Study Group

SG 4.1 -Pseudolite Applications in Positioning and Navigation

Chair: **Dr. Jinling Wang** (Australia)
Vice Chair: **Dr. Gethin Roberts** (UK)

Terms of Reference

In satellite-based precise positioning, the dominant factors are the number *and* geometric distribution of the satellites tracked by the receivers. In the case of Global Navigation Satellite Systems such as GPS, GLONASS, and the planned GALILEO system, four visible satellites are the minimum requirement for precise three-dimensional positioning. In general, the more satellites that are tracked, the more reliable the positioning solutions. However, in some situations, such as in downtown urban canyons, engineering construction sites, and in deep open-cut pits and mines, the number of visible satellites may not be sufficient. In the worst situations, such as in underground tunnels and inside buildings, the satellite signals may be completely absent.

Such problems with existing GNSS systems can be addressed by the inclusion of additional ranging signals transmitted from ground-based "pseudo-satellites" (pseudolites). Pseudolites are an exciting technology that can be used for a wide range of positioning and navigation applications, either as a substantial augmentation tool of space borne systems, or as an independent system for indoor positioning applications.

Objectives

The goal of this study group is to investigate new concepts of pseudolite-related positioning and navigation applications. The objectives of the research activities are to study:

- Pseudolite augmentation of GPS.
- Pseudolite-only positioning scenarios.
- Integration of pseudolites with other sensors, such as INS.

These objectives will be achieved by:

- Promoting dialogue between SG members.
- Encouraging symposia and sessions at conferences with the theme of pseudolite technology and applications.
- Setting up a SG website providing a focus for pseudolite research and applications with the relevant links.
- Developing a comprehensive bibliography for pseudolite research and applications.

Program of Activities

- To monitor research activities in the field of pseudolite development and application, across a wide range of positioning applications, including indoor and outdoor positioning.
- To report on the progress in research, performance, applications, availability, etc., of pseudolite systems, including seminars, position papers and via the SG4.1 web page.
- To organize and to participate in professional workshops, seminars, campaigns, meetings, etc.
- To establish a web page providing information on SG4.1 activities, technology updates, professional meeting calendar, etc.

Membership

Chair: Dr. Jinling Wang (Australia)
Vice Chair: Dr. Gethin Roberts (UK)
Vice Chair: Dr. Dorota Grejner-Brzezinska (USA)
Dr. Joel Barnes (Australia)
Prof. Elizabeth Cannon (Canada)
Prof. Paul Cross (UK)
Assoc. Prof. Peter Dare (Canada)
Dr. Liwen Dai (USA)
Dr. Fabio Dovis (Italy)
Prof. Xiufeng He (China)
Prof. Gunter W. Hein (Germany)
Assoc. Prof. Jonathan P. How (USA)
Dr. Hiroshi Isshiki (Japan)
Assoc. Prof. Changdon Kee (South Korea)
Prof. Alfred Leick (USA)
Dr. Edward LeMaster (USA)
Prof. Jingnan Liu (China)
Mr. Paolo Mulassano (Italy)
Dr. Xiaolin Meng (UK)
Dr. Ivan Petrovski (Japan)
Mr. Ilir F. Progri (USA)
Prof. Chris Rizos (Australia)
Dr. Fredrick von Schoultz (Finland)
Dr. Toshiaki Tsujii (Japan)
Ms. Sandra Verhagen (The Netherlands)
Dr. Guangjun Wen (Singapore)
Assoc. Prof. Ming Xie (Singapore)
Dr. Aigong Xu (Singapore)

Inter-Commission Study Group

IC-SG 4.2 - Statistics and Geometry in Mixed Integer Linear Models, with Applications to GPS and InSAR

(joint with ICCT)

Chair: **Athanasios Dermanis** (Greece)

Terms of Reference

The presence of an unknown number of cycles in GPS observations of phase differences has generated a new challenging theoretical problem, which in its utmost generality may be described as the solution of over-determined equations with both real-valued and integer unknowns. Within this problem these particular issues emerge: (a) the selection and design of an optimality criterion that leads to a unique solution, (b) the development of computationally efficient algorithms for obtaining the optimal solution, especially with respect to the integer unknowns which require search within a discrete set, (c) the new types of distributions of the estimated real-valued and integer parameters, (d) particular geometry in connection with the estimated integer parameters, (e) the assessment of the accuracy of the solution in the presence of both random and systematic errors affecting the observations, and (f) new statistical hypothesis testing techniques.

Objectives

- To attract the attention of researchers beyond geodesy (statisticians, mathematicians) to this fascinating topic, with a view towards finding other possible applications beyond those encountered in geodesy.
- To establish a channel of cooperation on the ground of methodology and support a closer collaboration between “theoreticians“ and “practitioners”.
- To encourage frontier research in the subject concerning e.g. the evaluation–comparison of various different solution principles (e.g. least squares, Bayesian statistics, best linear estimation) as well as of the different algorithms for the realization of the solutions.

Program of Activities

- Prepare a critical presentation of all relative literature.
- Prepare a “tutorial” monograph introducing the subject to the younger generation of researchers, which will include fundamental background material, but will also lead to the outskirts of advanced current research.
- Perform an extensive test of current methodologies and algorithms based upon real as well as properly designed simulated data.
- Establish a web page, which will serve as an open forum among all those interested in the subject.
- Organize a joint workshop on the subject with statistician and mathematicians and publish its minutes, if possible.

Membership

Chair: Athanasios Dermanis (Greece)
Mohamed Abdel-salam (Canada)
Clara de Lacy (Italy)
Donghyun (Don) Kim (Canada)
Georgia Fotopoulos (Canada)
Brigitte Gundlich (Netherlands)
Hung-Kyu Lee (Australia)
Kentaro Kondo (Japan)
Christopher Kotsakis (Greece)
Andre Lannes (France)
Linyuan Xia (China)
Marcelo Santos (Canada)
Burkhardt Schaffrin (USA)
Sandra Verhagen (Netherlands)