International Federation of Surveyors
Fédération Internationale des Géomètres
Internationale Vereinigung der Vermessungsingenieure

Commission 5: Positioning and Measurement

FACT SHEET
Standards and Best Practice for GNSS and CORS

Introduction
Surveyors as professionals must fulfil certain legal, regulatory and/or accuracy requirements for their clients. Typically they will strive to do this in an optimal cost effective way and with the most appropriate equipment for the job at hand. Naturally it requires a good understanding and assurance in the instrumentation employed.

Clients want the most from what they pay for. Legislative authorities as well as private and public companies require confidence that the services rendered are in conformity with globally accepted best practice rules. Generally this involves the application of internationally recognized standards.

Standards
A standard is a rule or requirement that is determined by a consensus opinion of users. It prescribes the accepted and (theoretically) the best criteria for a product, process, test, or procedure. The benefits of a standard are safety, quality, interchange ability of parts or systems, and consistency across international borders.

ISO (International Organization for Standardization) is the world's leading developer of International Standards. It is a global network that identifies and delivers international standards required by business, government and society. Several ISO standards are applicable to the Geomatics profession (the ISO 191XX family, ISO12858, ISO17123 and ISO9000).

The ISO 9000 standard is concerned with quality management. It represents an international consensus on good management practices aimed at ensuring a business or organization consistently delivers products or services that meet the customer's quality and regulatory requirements. An ISO 9001:2000 certification is considered proof of a supplier's capability to design, manufacture, and supply quality conforming products and services. This standard prescribes regular instrument calibration (if possible) and testing.

The ISO 191XX (6709, 19104, 19111, 19116, 19127, 19132, 19133, 19134, 19145) family concerns standardization in the field of digital geographic information. They aim 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. Of particular interest is ISO 19111 - Spatial referencing by coordinates (i.e. geodesy).

The ISO17123 series (parts 1 through 8) of standards are concerned with instrument testing. Specifically the newly published ISO17123 part 8 "GNSS field measurement systems in real time kinematic (RTK)" concerns the field testing procedures for of GNSS.

What is Best Practice?
Best Practice is a management idea which asserts that there is a technique or method that is more effective and efficient at delivering a particular outcome than any other. It maintains that with proper processes, checks, and testing, a desired outcome can be delivered with fewer problems and unforeseen complications. Best practice is generally based on repeatable procedures that have proven themselves over time for large numbers of people. The notion of best practice does not commit people or companies to one inflexible, unchanging practice. Instead, it is an approach that encourages continuous learning and improvement. Best practice in a field can be

expected to evolve as new information, instrumentation and methodology becomes available.

Best practice in surveying and GNSS in particular may have some very job specific aspects associated with it. There may be accompanying legal and/or legislative imperatives that do not impact directly on the measurement process and thus strongly influence what may otherwise be regarded as the best practice approach to the job.

Regardless of the specificity of the job, normally an important objective in a survey is to get the best possible results. This is typically synonymous with the highest attainable precision. Bearing this in mind, there are several commonly accepted generic guidelines for GNSS which can be regarded as best practice to achieve optimal measurement results. These guidelines typically minimise the errors associated with GNSS measurements.

Common GNSS Errors

Listed below are several well known and common GNSS errors that degrade the accuracy of derived coordinates in surveying applications:

- Multi-path and Electrical Interference,
- Obstructions,
- Ionospheric and Tropospheric influences,
- Incorrect Integer Ambiguity,
- Dilution of Precision (DOP) and Satellite Availability (SA),
- Inappropriately long Baseline Length,
- Lack of network redundancy,
- Use of poor quality or degraded benchmark and/or datum references,
- Malfunctioning equipment,
- Blunders and human errors due to ignorance and bad survey practice.

It should be noted that errors are often more likely to occur or to be exacerbated in RTK surveys because of the relatively short occupation times used.

GNSS Best Practice Guidelines

Best practice in GNSS strives to avoid or minimise errors while supplying appropriately documented measurements by providing (legally) traceable measurements using an (inter)nationally recognised reference network. Equipment should be correctly functioning and field tested (ISO 17123 part 8). Properly trained personnel prepared to confront the multiplicity of field situations will always make the difference between a good or bad survey.

Typically a survey should be connected into several (at least 3) stations in the reference network. They should become part of the survey and should be used to constrain it. The level of agreement between measured and reference values must conform to the precision required for the survey, the GNSS technique employed and the client accuracy specifications. For example, if one metre accuracy is required using differential GNSS, then the measured and reference values should agree to within 1 metre.

The connections to reference stations should be documented, outlining the GNSS technique and reduction process, least squares adjustments, and a comparison/analysis of the derived values. Archiving of raw observation data and results files is highly recommended.

Author of the fact sheet

This fact sheet was produced for FIG Commission 5 by –
David Martin, France, martin@esrf.fr

Feedback and comments are encouraged on the usefulness of the fact sheet.

References

There is a considerable amount of useful information available on the web. For example one can consult:

- http://www.ngs.noaa.gov/PC_PROD/WorkShops
- http://www.icsm.gov.au/icsm/publications/sp1/sp1v1-6.pdf
- http://www.iso.org