

Use of Nummela Standard Baseline in Present-Day European Metrology Research

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Key words: Engineering survey; Reference frames; Standards; metrology, traceability, geodetic baseline, calibration, best practices

SUMMARY

The Finnish Geospatial Research Institute FGI (known until 2014 as the Finnish Geodetic Institute) is a National Standards Laboratory for length in Finland. This presentation is an overview of FGI's recent international activities and scientific results related to metrology of long distance surveying.

The FGI re-measured its renowned Nummela Standard Baseline using the Väisälä (white-light) interference comparator in autumn 2013. New absolute calibrations for the comparator's quartz gauges in 2015 provide the traceability of scale to the SI unit metre. The remeasurement confirms the excellent stability of the 80-years-old geodetic baseline and 0.1-mm-level standard uncertainties for the baseline section lengths up to 864 m. Results and the interface to exploit them in present-day calibrations are presented.

Nummela Standard Baseline was utilized in the European Metrology Research Programme (EMRP) joint research project SIB60, "Metrology for long distance surveying", jointly funded by ten EMRP participating countries within EURAMET and European Union. The FGI used the Nummela scale to calibrate the German geodetic baselines of UniBW in München and PTB in Braunschweig in 2014. High-precision EDM equipment was used as transfer standard.

Two novel refractivity-compensated distance meters, German PTB's TeleYAG and French CNAM's TeleDiode, were successfully tested at Nummela in 2015–2016. Simultaneously with PTB's Nummela measurements VTT-MIKES tested a spectroscopic thermometer for geodetic measurements. The purpose of these comparisons of baselines and measurement methods is to improve traceability and decrease measurement uncertainty.

The traceable scale from Nummela is also available at FGI's Metsähovi Fundamental Geodetic

Station, in the control network around the reference points of observation sites for global geodesy (GNSS, SLR, VLBI). Improving this network and methods for local tie measurements between the reference points was one part of the SIB60 project. Sub-millimetre positioning uncertainties are needed for the maintenance and development of reference frames.

For research and validation of GNSS antenna calibration results the Metsähovi control network was expanded by constructing a hexagonal 7-pillar test field. Both models and simulations and field tests were used in research of uncertainty of GNSS-based distance metrology, also a part of the SIB60 project. The results of the project include new good practice guides both for calibration of EDMs on baselines and for high accuracy GNSS based distance metrology.

FGI's bilateral metrology projects include control of national calibration baselines. Recent examples are the repeated calibrations at Kyviskes, Lithuania (1997–2014) and Innsbruck, Austria (2008–2015), and a scale transfer to China (2015). The height component is not forgotten: FGI's laboratory premises serve in calibration of precise levelling instruments and systems worldwide.

Use of Nummela Standard Baseline in Present-Day European Metrology Research (8971)
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FIG Working Week 2017
Surveying the world of tomorrow - From digitalisation to augmented reality
Helsinki, Finland, May 29–June 2, 2017