

FIG

FIG WORKING WEEK 2017

Helsinki Finland

29 May - 2 June 2017

Presented at the FIG Working Week 2017,
May 29 - June 2, 2017 in Helsinki, Finland

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

Dr. Jorma Jokela

Department of Geodesy and Geodynamics
Finnish Geospatial Research Institute (FGI)
Kirkkonummi, Finland

Surveying the world of tomorrow -
From digitalisation to augmented reality

Organised by



Platinum Sponsors:





FIG WORKING WEEK 2017

Surveying the world of tomorrow -

Helsinki Finland 29 May - 2 June 2017

From digitalisation to augmented reality

Services of Nummela Standard Baseline

- Results of interference measurements as an (inter)national standard for metrological research and practical purposes
 - Scale traceable to the SI unit metre with known uncertainty
- Highest accuracy calibrations of EDM instruments
- Scale transfer measurements and comparisons
 - Within European Metrology Research Programme (EMRP)
 - PTB, UniBW, CNAM; Metsähovi
 - Bilateral
 - Finland–Lithuania as an example



Platinum Sponsors:



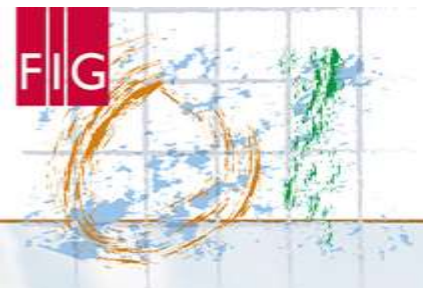


FIG WORKING WEEK 2017

Surveying the world of tomorrow -

Helsinki Finland 29 May - 2 June 2017

From digitalisation to augmented reality

Traceability chain in geodetic length measurements utilizing a Väisälä Baseline

Definition of the metre and its realization

Quartz gauge system

Measurement of a standard baseline using the Väisälä interference comparator

Calibration of a transfer standard (or other EDM equipment) at a standard baseline

Scale transfer measurements at another baseline or test field



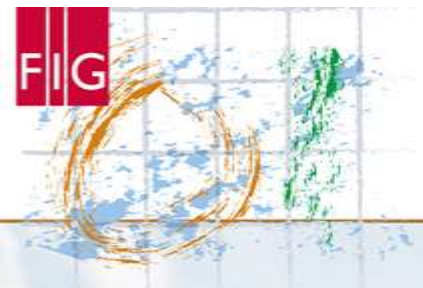


FIG WORKING WEEK 2017

Surveying the world of tomorrow -

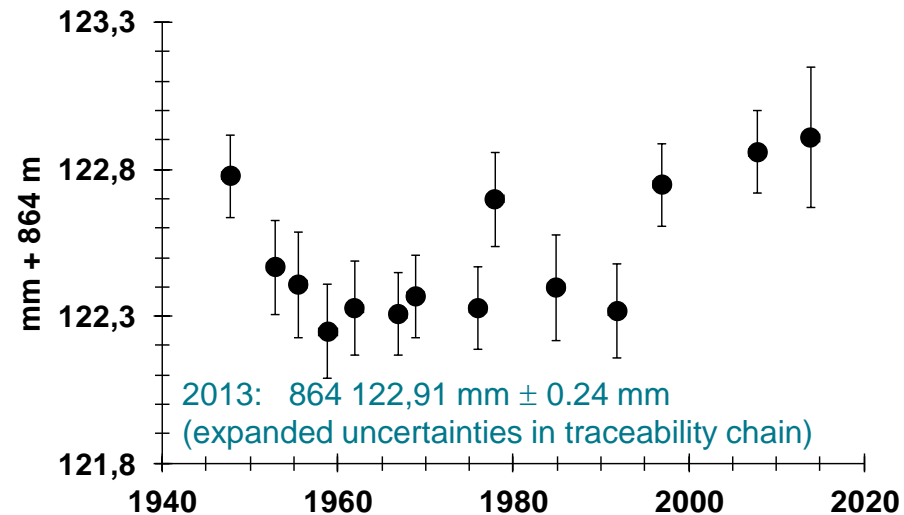
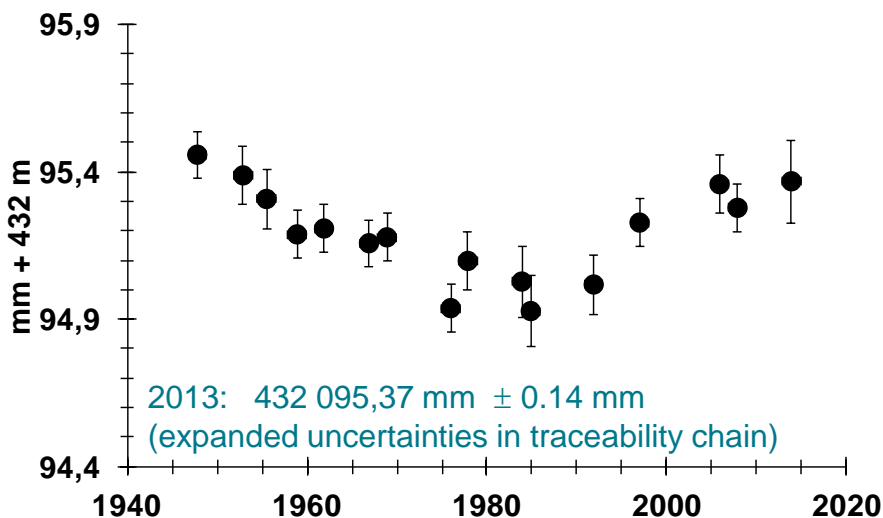
Helsinki

From digitalisation to augmented reality



Time series 1947–2013 of Nummela Standard Baseline lengths

- Typically 0.02 mm to 0.09 mm standard uncertainties; < 0.7 mm variations in 70 years
- Large uncertainty in 2013 caused by severe weather conditions
- Much of the variation is probably due to challenges in working with the quartz gauge: 100 nm uncertainties at 1 m would accumulate to nearly 0.1 mm at 864 m



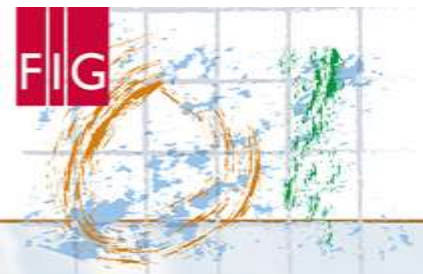


FIG WORKING WEEK 2017

Surveying the world of tomorrow -

Helsinki Finland 29 May - 2 June 2017

From digitalisation to augmented reality

European Metrology Research Programme (EMRP) Joint Research Project (JRP) tasks at Nummela

- "Absolute Long Distance Measurement in Air" 2008–2011
- "Metrology for Long Distance Surveying" 2013–2016
 - PTB, Germany, tested TeleYAG, a refractivity compensated EDM based on interferometry with four different wavelengths using YAG lasers at 1 064 nm and frequency doubled radiations at 532 nm
 - CNAM, France, tested Telediode, a refractivity compensated EDM based on diode lasers



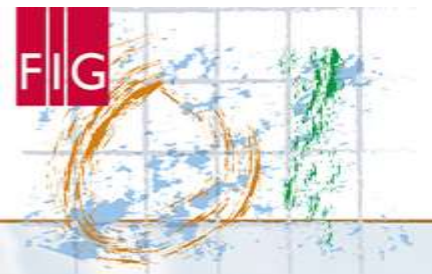


FIG WORKING WEEK 2017

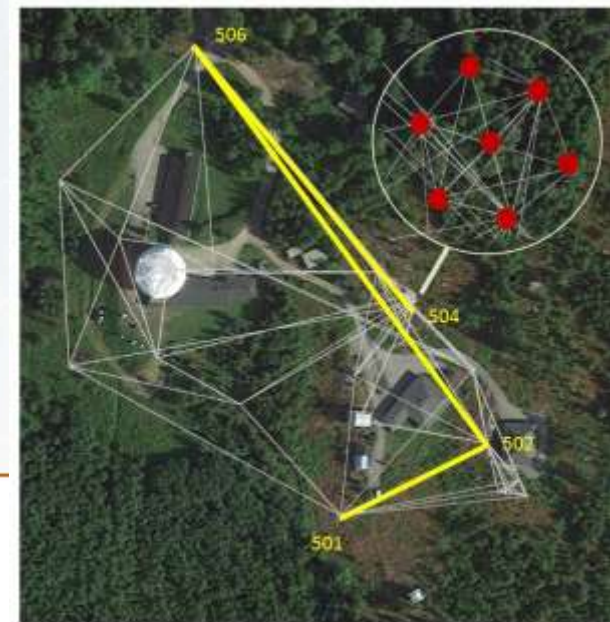
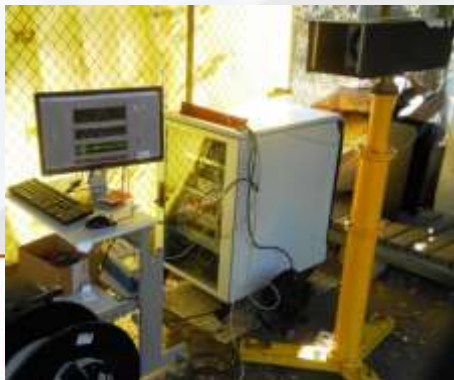
Surveying the world of tomorrow -

Helsinki Finland 29 May - 2 June 2017

From digitalisation to augmented reality

European Metrology Research Programme (EMRP) Joint Research Project (JRP) tasks at Nummela

- "Metrology for Long Distance Surveying" 2013–2016
 - VTT-MIKES, Finland, tested spectroscopic temperature measurement for geodetic measurements
 - FGI determined the traceable scale in the GNSS test field and local ties network for global geodesy applications at FGI's Metsähovi Geodetic Fundamental Station



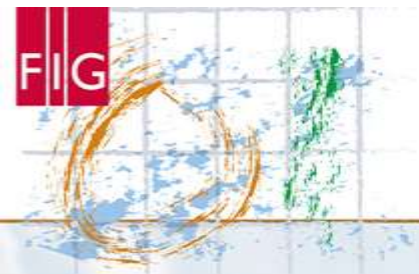


FIG WORKING WEEK 2017

Surveying the world of tomorrow -

Helsinki Finland 29 May - 2 June 2017

From digitalisation to augmented reality

European Metrology Research Programme (EMRP) Joint Research Project (JRP) tasks at Nummela

- Using the Nummela scale and high-precision EDM as transfer standard, FGI calibrated the geodetic baselines of PTB, Braunschweig, and UniBW München, Neubiberg in Germany
- Observation data from traditional and novel instruments from the selected baselines computed and analyzed uniformly by TUBS, Germany (not published yet)



Platinum Sponsors:



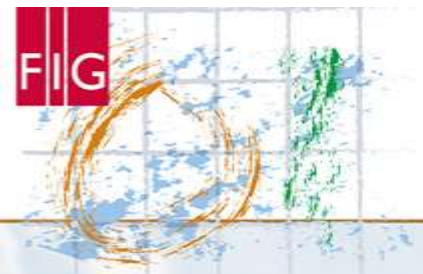


FIG WORKING WEEK 2017

Surveying the world of tomorrow -

Helsinki Finland 29 May - 2 June 2017

From digitalisation to augmented reality

New good practice guides

- EMRP JRP SIB60 deliverables
- for calibration of electro-optic distance meters on baselines
 - requirements for reference baselines
 - recommendations for calibration measurements
 - data processing
 - measurement uncertainty
 - presentation of results
- for high accuracy GNSS based distance metrology

EMRP

European Metrology Research Programme
Programme of EURAMET



The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

<http://www.ptb.de/emrp/sib60-home.html>



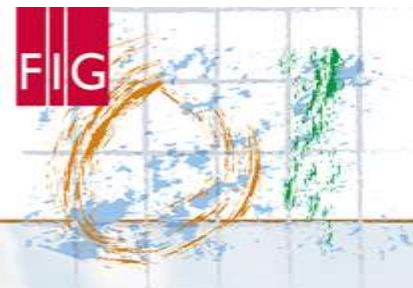


FIG WORKING WEEK 2017

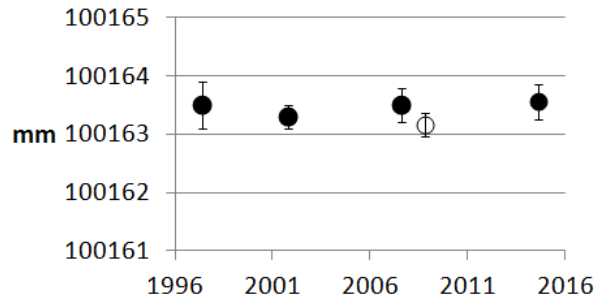
Surveying the world of tomorrow -

Helsinki Finland 29 May - 2 June 2017

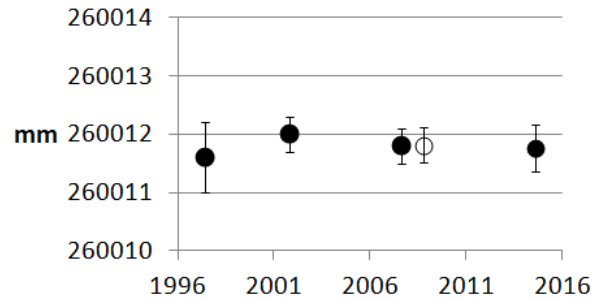
From digitalisation to augmented reality

Calibration (using scale transfer from Nummela) of Kyviškės calibration baseline (VGTU, Lithuania), time series 1996–2014

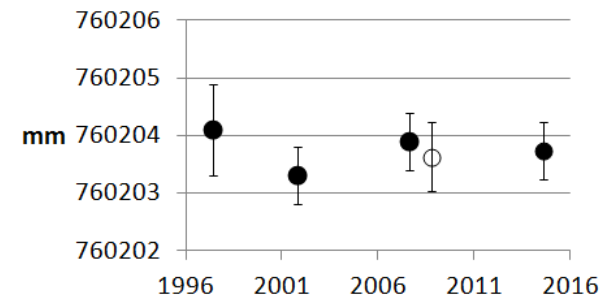
1 - 2, 100 m



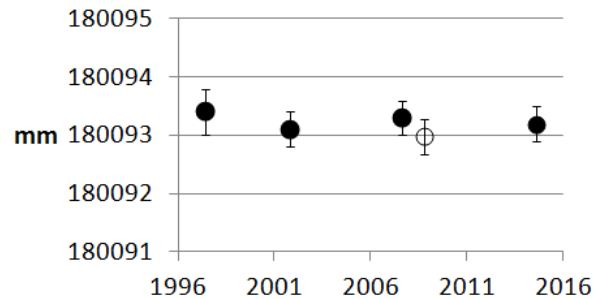
2 - 3, 260 m



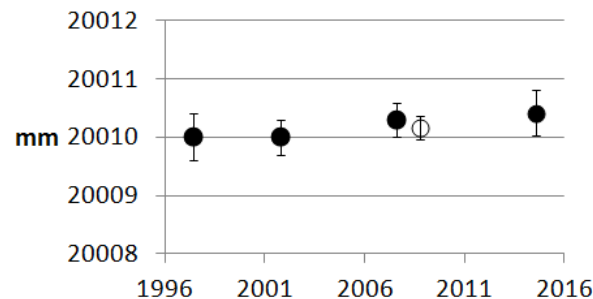
3 - 4, 760 m



4 - 5, 180 m



5 - 6, 20 m



Lengths with expanded uncertainties,
k = 2; 95 %

Platinum Sponsors:





FIG WORKING WEEK 2017

Surveying the world of tomorrow -

Helsinki Finland 29 May - 2 June 2017

From digitalisation to augmented reality

Outcome – Use of Nummela Standard Baseline in Present-day European Metrology Research –

- World-class geodetic measurement standard maintained
 - New absolute calibration results of quartz gauges
 - New interference measurement results using the Väisälä interference comparator
 - Regular projections keep the Nummela Standard Baseline continuously usable for the highest accuracy distance measurement applications
 - Prerequisite for participation in international metrological R&D projects (EMRP, EMPIR)
- New distance measurement instrument prototypes tested
- New good practice guides for surveyors composed
- Dissemination of the SI unit system by transferring the traceable scale
 - For scientific and practical purposes
 - For international comparisons and for development of national calibration services



Platinum Sponsors:

