Physikalisch-Technische Bundesanstalt
Braunschweig and Berlin
National Metrology Institute

METROLOGY PARTNERSHIP | EURAMET

Metrology Partnership Call 2023:

23NRM01
Support for standardisation of sample-by-sample waveform uncertainty computation

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SBS-Uncert: Main Objective

Setting up a new IEC standard

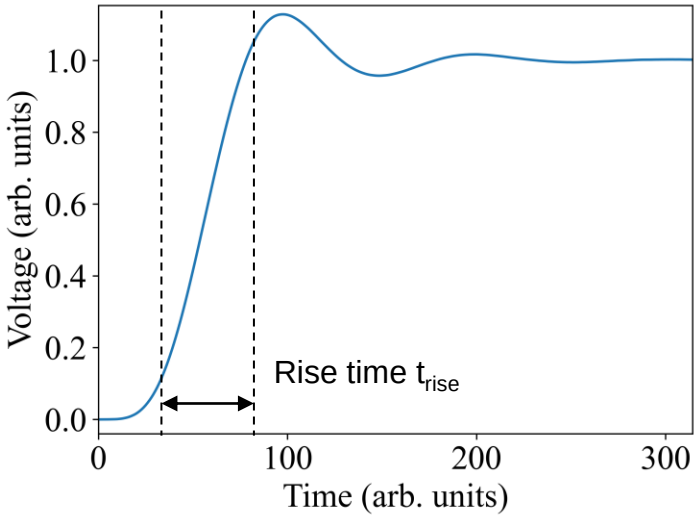
- Working title
  Computation of Sample-by-Sample Waveform Uncertainties

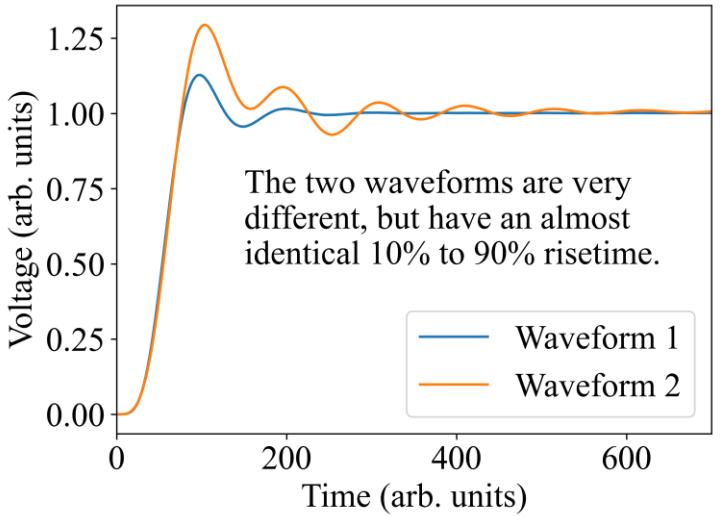
- Complements existing standard IEC 62754
  Computation of waveform parameter uncertainties

- Content: **Full waveform metrology**
  - Based on multivariate sample-by-sample uncertainty analysis
  - Delivers reconstructed waveform + covariance matrix (i.e. uncertainties)
  - Accounts for data processing effects and correlated errors
  - Helps industry to channel flood of data (IoT, automatization, digitalization)

SBS-Uncert: Why is this important?

1. Waveform description by parameter is ambiguous!

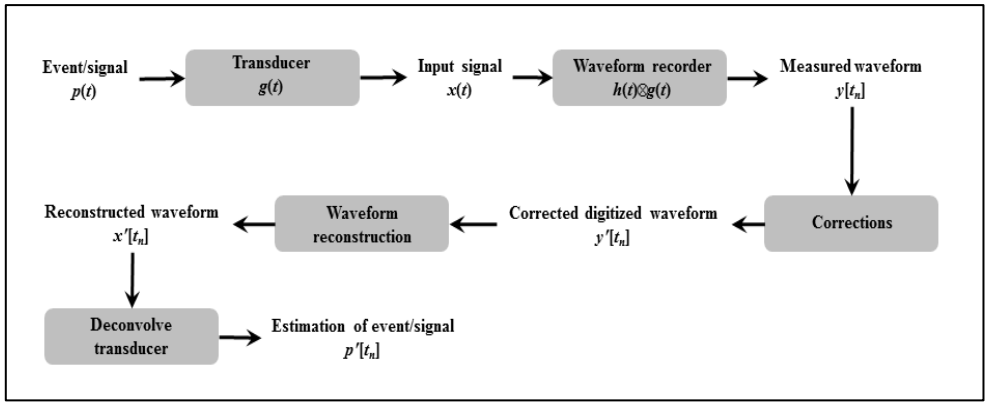




➔ Device performance / system behavior / accreditation might be affected

SBS-Uncert: Why is this important?

2. Data processing affects the uncertainty of the result!



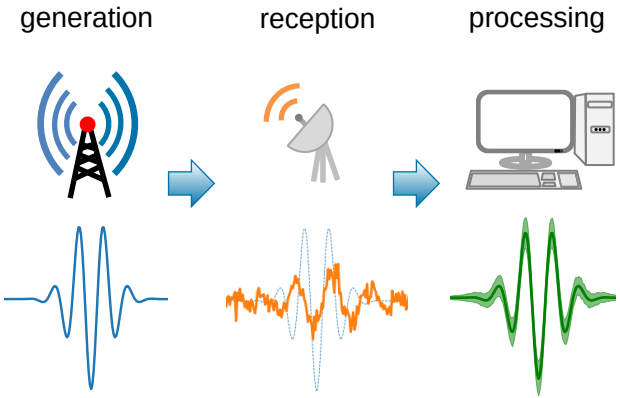
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Figure 3 – Creation of measured, corrected, and reconstructed waveforms and the final estimate of the input signal

➔ Waveform-correction, -reconstruction, -deconvolution effects to be considered

* IEC 60469:2013

SBS-Uncert: Content



For distinct use cases:

- Analyse data generation / reception paths
- Set up waveform correction / reconstruction methods with full-waveform uncertainty propagation
- Optimize data processing (computational limitations)
- Implement + publish user-friendly software libraries
- Feed results towards IEC standardization process

SBS-Uncert: Project structure

three use-cases:

Communication technologies

Photodiode	PTB
Electrical Pulse Gen.	CMI
Sampling oscilloscopes	TUBITAK
Real-time oscilloscopes	EMCC
	Tektronix

Low-frequency electronics

Jaws	CMI
PJVS	TUBITAK
RC Oscillator	LNE
ADCs	EMCC

Power-grid waveforms

Impulsive waveforms	UStrathclyde
- Measurement sets	UPV/EHU
- Simulated data	TUBITAK

Per use-case:

WP1: Waveform generation and measurement

1. Modelling of measurement scenarios
2. Analyzing and characterizing impairments
3. Acquiring data sets

WP2: Data processing methods

1. Waveform correction and reconstruction methods
2. Validation of models and methods
3. Set up software libraries

WP3: Computationally fast waveform correction methods

1. Advanced Monte Carlo
2. Compact covariance
3. Real-time computation

Throughout, focus on digitalization:

well-defined data formats, open source libraries, online-service for data processing within International Data Spaces (IDS) initiative

SBS-Uncert: Consortium

Consortium

6 leading NMI's / universities

4 pioneering SME's / industry partners / calibration laboratories

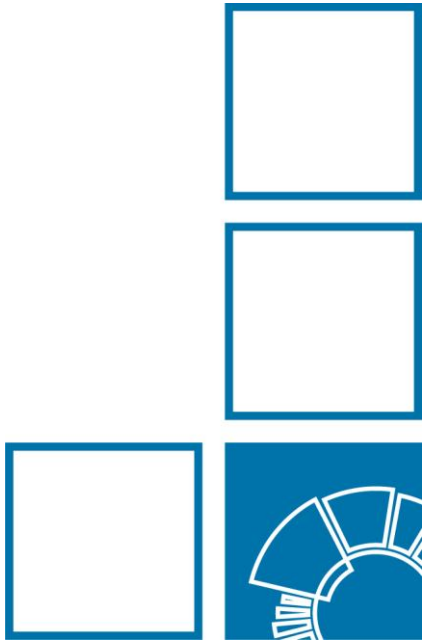
Stakeholder:

Project frame
- 10 partners: NMIs, Universities, Industry
- Project duration: 36 Months
- Funding: 1.3 M€

Coordination
- Phyikalisch-Technische Bundesanstalt (PTB)
- Heiko Füser (heiko.fueser@ptb.de)

start date
- 01.08.2024

Thank you for you attention!

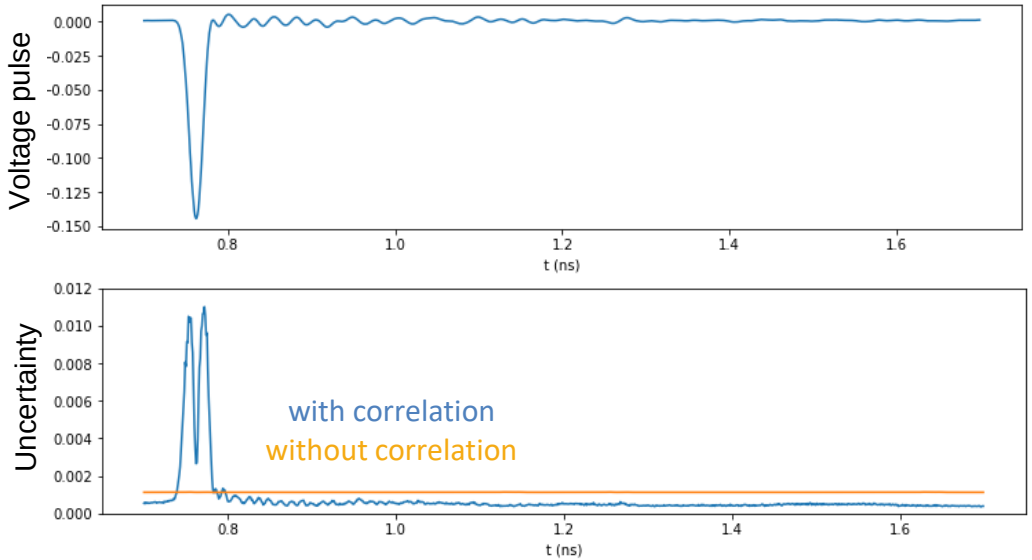


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SBS-Uncert: Why is this important?

3. Interpretation of the data requires knowledge of correlation!



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Special focus:

time-frequency conversion
(Fast Fourier Transform)

ignoring correlation
= incorrectly transferring
uncertainty between domains

➔ Account for correlated errors within uncertainty analysis

* National Instruments, Frans Verbeyst