Application of the Nordtest method for real-time uncertainty estimation of on-line field measurement

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Visualisation Tool

Parameters described in the paper can be adjusted and their influence on the measurement uncertainty can be assessed visually using the visualisation tool developed. In the visualisation tool the user can set the parameters for the measurement uncertainty calculation. After that the operator can see how the changes of the parameters affect the calculated measurement uncertainty. The visualisation tool uses the “forced” mode of AutoMUkit.

The examples of the graphs available are presented in Figures 2-5. The graphs include e.g. the presentation of measurement results and their uncertainties \( k = 2 \) shown using error bars (Fig. 2). X chart is available for visual monitoring of the measurement results of control samples (Fig. 3). Also \( r\% \) chart is available in Fig. 4, where each dot is calculated from the difference of routine sample replicate results as a percentage of their mean value \( (r\% \text{ value}) \). \( r\% \) values may be viewed also as a function of time, so the operator can observe possible changes in the random variation due to seasonal effects (Fig. 5).
**Fig. 1** A screenshot for the table of setting parameters for the AutoMUkit visualisation tool

**AutoMUkit – Parameter adjusting**

With "AutoMUkit – Parameter adjusting" you can see how different parameters for the "AutoMUkit" application affect the measurement uncertainties.

### Settings for the first concentration level
- ID of the first concentration level
- Minimum and maximum concentrations for the first concentration level
- Measurement as percentages?
- Certified value of control sample
- Uncertainty of the certified value of control sample
- How many days uncertainty calculation is valid
- Time interval (in days) for collecting results of routine sample replicates for repeatability estimate, reference (control) samples for bias estimate and control samples for within-instrument reproducibility estimate.
- Counting from the date the uncertainty estimation is carried out, how many days in the future the measurement results are included for uncertainty estimation
- Minimum number of days from which measurement results have to be found for replicate, reference and control samples
- Minimum number of measurement results that have to be found for replicate, reference and control samples
- Dates limiting the queries of the measurement results and evaluation of measurement uncertainty

The graphs can be viewed for measurement uncertainties or X- and R-charts (see Figs. 2-5)

### Settings for the second concentration level
- Not all the settings are visible

**Fig. 2** Measurement results with their uncertainties ($k = 2$) versus time for an online turbidity measuring system

*B Conc. Range Min./Max.* shows the minimum and maximum concentrations for control sample B (=low concentration level).

*C Conc. Range Min./Max.* shows the minimum and maximum concentrations for control sample C (=high concentration level).
Fig. 3 X chart describing the measurement results of control samples versus time for an on-line turbidity measuring system

Fig. 4 r% chart, where r% values are presented as a function of turbidity values for an on-line turbidity measuring system

Fig. 5 r% chart, where r% values are presented as a function of time for an on-line turbidity measuring system