# COOMET RECOMMENDATION «EXPRESSION OF THE EXPANDED MEASUREMENT UNCERTAINTY (METHOD OF KURTOSIS)»

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In 1993, the "Guide to the Expression of Uncertainty of Measurement" (GUM) [1] was published, which was based on: the law of propagation of uncertainty, leading to a bias in estimates of the numerical values of the measured quantity and its uncertainty under nonlinear model equations; central limit theorem of the theory of probability with the apparatus of the number of degrees of freedom, predetermining the unreliability of estimates of expanded uncertainty due to ignoring the influence of the distribution laws of input quantities on the distribution law of the measured quantity.

The introduction of Appendices 1 to the GUM [2], based on the Monte Carlo method (MCM), made it possible to get rid of these shortcomings. The estimates of measurement uncertainty obtained using the MCM correspond to Bayesian estimates, but differ numerically from the estimates obtained using the GUM approach. It should be noted that the following factors impede the direct use of MCM for assessing measurement uncertainty in testing and calibration laboratories accredited for compliance with the requirements of ISO/IEC 17025: 2017 [4]:

• lack of specialized certified software for estimating measurement uncertainty based on MCM;

• fulfillment by the existing software of the impossibility of implementing MCM of the measurement uncertainty budget;

• impossibility of documenting a step-by-step procedure for estimating measurement uncertainty based on MCM.

As part of the implementation of the COOMET topic 796UA19_2019, the Recommendation “Expression of expanded measurement uncertainty (method of kurtosis)” was developed, which allows obtaining estimates of numerical values and uncertainty of the measurement result close to the estimates obtained using the MMC [4].

The Recommendation include the following sections:

1. INTRODUCTION
2. CONDITIONS OF USE
3. NOTATION USED
4. GENERAL PROVISIONS
4.1. Measurement model
4.2. Evaluation of input quantities, their standard uncertainties and covariances
4.3. Calculation of the numerical value of the measurement result
4.4. Calculation of the measurand standard uncertainty
5. CALCULATION OF EXPANDED UNCERTAINTY
5.1. Kurtosis method [5-6].
5.2. The expanded uncertainty propagation law [7].

APPENDIX A. Finding the parameters of distributions by coverage factor

APPENDIX B. Taking into account the bias of the numerical value of the measurand with a nonlinear model equation [8]

APPENDIX C. Accounting for the bias of the standard uncertainty of the measurand at a nonlinear model equation [9]

APPENDIX D. Student's coefficients for the number of degrees of freedom ν and probabilities 0,95 and 0,9545

APPENDIX E. List of publications with examples of estimation of measurement uncertainty by the proposed methods

BIBLIOGRAPHY

INFORMATION DATA

The draft COOMET Recommendations “Expression of expanded measurement uncertainty (method of kurtosis)” was approved at the meeting of the COOMET President's Council on 25.11.2021. The official approval and assignment of the number of the Recommendation will be carried out at the 33rd meeting of the COOMET Committee (June 2022).

## References


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2. JCGM 101:2008. Evaluation of measurement data – Supplement 1 to the “Guide to the expression of uncertainty in measurement” – Propagation of distributions using a Monte Carlo method. JCGM, 2008. 90 p.

3. Bich W., Cox M., Michotte C. Towards a new GUM − an update. Metrologia 53. 2016. S149–S159.

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