

ABSTRACT for MATHMET 2014

Merging PDFs

Ignacio Lira¹ and Dieter Grientschnig²

¹Department of Mechanical and Metallurgical Engineering, Pontificia Universidad Católica de Chile, Vicuña Mackenna 4860, Santiago, Chile. ilira@ing.puc.cl

²Chemical Laboratories, Boehler Edelstahl, Mariazeller Str. 25, 8605 Kapfenberg, Austria. Dieter.Grientschnig@boehler-edelstahl.at

It happens in metrology that the value of a measurand is determined under reproducibility conditions of measurement, i.e. in different locations, by different operators, using different measurement procedures, etc. Each of these different conditions will produce a state-of-knowledge probability density function (PDF) for the value of the measurand that will not exactly match all other PDFs for the same quantity. We here refer to these PDFs as being *concurrent*. Is it reasonable to merge all of them to produce just a single PDF, out of which the value of the measurand and its uncertainty can be determined? Or should additional quantities be introduced to account for differences in the individual estimates of the measurand that are judged to be unreasonably large?

In the present talk we discuss some of these issues. We focus on a specific example involving the calibration of a gauge block. We suggest that the length of the block at the reference temperature should be inferred by merging two PDFs: the one derived from measurements at the calibration temperature with the one deduced from the results of the previous calibration. We discuss two merging methods. These are weighted logarithmic pooling and weighted linear pooling. To avoid logical inconsistencies, we suggest that in both pooling methods the weights should be selected such that their sum equals one. We also recommend a procedure to be followed in case the concurrent PDFs are found to be so dissimilar that their merging seems inadvisable.