METTI5 Tutorial on Analysis of Error Factors for Measurement Data and Inverse Techniques, Application to Temperature Measurements and Heat Flux Estimations

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Duration

1h

Type

Methodological, Experimental

Content

I Methodology

The present document provides a complete methodology for the determination of inverse techniques uncertainties. The methodology is based on the Monte Carlo Method. It includes two steps:

- The first step is the **characterization of measurement errors**. The measurement errors can be described as t-distribution random variables. The document provides some details about the different calculation steps which, from a set of raw data measurements, lead to the determination of the total error random variable and the uncertainty on the measurement.

  The measurement total error is caused by various physical phenomena which may be identified. Those phenomena are called **error factors**. The document shows how to decompose the total error into a sum of errors associated to the error factors, and how to obtain the t-distribution random variables which describe those associated errors. The decomposition of the total error allows a better characterization of measurement errors.

- The second step is the **generation of noised input populations**, which is then used for the Monte Carlo method. Special input populations can be generated in order to evaluated the principal error factors which are responsible to the inverse techniques uncertainty.

II Application

The methodology which is described in the document has been applied to an inverse technique, which is used to obtain **heat flux values** at the surface of a wall, from **temperature measurements**. The temperature uncertainties are calculated from the calibration measurement

data, by considering two error factors: the electromagnetic noise, and the calibration curve error.

Then, different input populations are generated for the evaluation of the heat flux uncertainty. The analysis of the results provides a detailed description of the effect of the different error factors on the final uncertainty.