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Special Section on Mathematical and Statistical Methods for Metrology (EDITORIALE)

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# Special Section on Mathematical and Statistical Methods for Metrology

**Guest Editors:** Prof. Grazia Vicario (Politecnico di Torino) and Dr. Francesca Pennechi (INRIM - Istituto Nazionale di Ricerca Metrologica)

The idea of this special issue came about from the joint Workshop of *it*ENBIS and INRIM, Mathematical and Statistical Methods for Metrology (MSMM 2019, <http://www.msmm2019.polito.it/>) held on May 30–31, 2019 in Torino (Italy) at the INRIM, with the co-chairing of Prof. Grazia Vicario (PoliTo/*it*ENBIS) and Dr. Francesca Pennechi (INRIM/ENBIS). *it*ENBIS is the Italian local network of ENBIS (European Network on Business and Industrial Statistics, <http://www.enbis.org/>), which is an organization aiming to promote the widespread use of sound science-driven and applied statistical methods in European business and industry. The Italian local network is a group of Italian ENBIS members that commit themselves to the ENBIS mission while operating on the national scale. INRIM is the National Institute of Metrological Research (<https://www.inrim.it/>). It is a public research body having the role of National Metrology Institute (NMI), with the responsibility for carrying out and promoting scientific research in metrology. INRIM realises, maintains and develops the national reference standards of the measurement units of the International System (SI).

Both *it*ENBIS and INRIM acknowledged the increasing need of ad hoc and innovative mathematical and statistical tools for current and emerging metrological applications in the several areas of the science of measurements. Hence, the aim of the workshop was to join common areas of interest for metrologists and mathematical statisticians. In fact, the need for new methods and new tools requires the development of novel theoretical and applied statistical ideas that ease collaboration with scientists and professionals in metrology, encouraging the connection between theory and application of the statistical methodologies in it. This special feature of Measurement Science and Technology contains four papers selected from contributions to the MSMM 2019 Workshop:

- ***Bayesian inference on the parameters of the truncated normal distribution and application to reverberation chamber measurement data***, by Serra and Carobbi [1]. The paper deals with the assessment of the performance of reverberation chambers in terms of the uniformity of the electromagnetic field within the chamber. The authors contribute to this problem by introducing a new methodology able to estimate the distribution of the statistical parameters of interest. The analysis is based on Bayesian inference and it is applied to two different statistical models (normal and truncated normal distribution) for the measurement data and to two different loading conditions of the chamber.
- ***A method to deal with correlations affecting  $\gamma$  counting efficiencies in analytical chemistry measurements performed by  $k_0$ -NAA***, by Di Luzio, D'Agostino and Oddone [2]. The paper fits in the area of nuclear counting, focusing on the ratio of  $\gamma$  counting efficiencies, very important in trace element analysis. The effect of correlation in counting efficiencies is well known and methods have been developed in prompt- $\gamma$  neutron activation analysis to correctly evaluate

the associated uncertainty. However, corresponding counterparts in delayed- $\gamma$  neutron activation analysis are still missing. The main aim of the paper is to fill this gap: the authors propose a new method, based on the use of reference  $\gamma$ -sources, relying on a measurement model that differs from the classical  $k_0$  formulation.

- ***Calibration curve computing (CCC) software v2.0: A new release of the INRIM regression tool***, by Lecuna, Penneccchi, Malengo and Spazzini [3]. The Calibration Curve Computing (CCC) is a software for regression analysis freely downloadable from the INRIM website. It is able to perform ordinary, weighted and weighted total least square regression, fitting fractional polynomials with positive and negative exponents up to the fifth order. The main feature of the paper is the comparison between the first release of the software and the new one (version 2.0), whose main improvements concern graphical aspects and calculation functionalities, such as the enhanced accuracy obtained in the weighted total least square estimates.
- ***Clustering on Laplacian-embedded latent manifolds when clusters overlap***, by Chretien, Jagan and Barton [4]. The problem of data clustering when clusters overlap is addressed by the authors. They examine how the modes of the distribution of the raw data are mapped to the modes of the data after they are embedded via Laplacian Eigenmaps. The modes are proved to be preserved and the proposed approach shows a performance comparable with the technique of finding modes in the original high dimensional space, but offering a much better computational efficiency. The method is illustrated on both simulated data and satellite data of ground movement.

The Guest Editors wish to thank the authors who submitted their papers for publication into this special issue and all the reviewers who went very carefully through these contributions, leading to a significant improvement of their quality. A special thank goes to Ian Forbes, Editors-in-Chief of Measurement Science and Technology (MST), and to the entire editorial board of the journal for kindly accepting to host the issue and for all the support provided during each step of its preparation.

Francesca Penneccchi and Grazia Vicario

[1] Ramiro Serra and Carlo Carobbi 2020 *Meas. Sci. Technol.* **31** 074003

[2] M Di Luzio *et al* 2020 *Meas. Sci. Technol.* **31** 074006

[3] Maricarmen Lecuna *et al* (in press) <https://doi.org/10.1088/1361-6501/ab7d6e>

[4] Stephane Chretien *et al* (in press) <https://doi.org/10.1088/1361-6501/ab934e>