



HOT TOPIC 6: Metrology and measurement science in acoustics

How metrology and measurements science in acoustics allow supporting the fundamental scientific research, the industry and the incoming technological development: from applications to future trends

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ABSTRACT

Metrology primarily aims at providing measurement traceability, i.e. the process by which the physical phenomena detected by a measurement system are quantified in a precise, accurate and reproducible way. The reliability of measurement results, which implies a correct assessment of their uncertainty, is the basis of experimental verification in any scientific and technical field. It supports fundamental research, favours the improvement of industrial production processes; enhances the effectiveness of applied technologies for health, environment, and energy; guarantees the functionality of newly-developed *smart-systems*, and provides access to available data for the sake of meaningful comparisons.

In the field of acoustics, metrology makes it possible to ensure, and certify through calibration, that a specific measuring instrument, such as a microphone or a sound level meter, provides truly correct and comparable results, which can be exploited for the trustworthiness of measurements and to improve the truth likeness of the computational models. Beyond this, acoustics measurements are used to achieve accurate determinations of the thermophysical properties of fluids and solids, to realize the most accurate primary standards of temperature, as well as for applications of ultrasounds in medicine and surgery, and to develop advanced monitoring and survey systems, based on wide sensor networks and digital smart technologies.

TRAINING FLOW

1. Introduction to Metrology: the International Systems of Units, definitions, the AUV field (Alessandro Schiavi)
2. Metrology in Acoustics: Sound in air; microphone & sound level meter calibration (Fabio Saba).
3. Metrology in Ultrasound: parameters used in ultrasonic field characterization (Giovanni Durando)
4. Metrology in Vibrations: Structure-borne sound, accelerometers (Alessandro Schiavi)
5. Metrology in digital smart systems, MEMS, and sensor networks (Alessandro Schiavi e Fabio Saba)



6. The measure of listening (Laura Rossi)
7. Physical acoustics and fluid metrology (Roberto Gavioso)
8. Acoustic thermometry (Roberto Gavioso)
9. Transport properties in permeable materials (Alessandro Schiavi)
10. Application of ultrasound in therapy (Giovanni Durando)

KEY TRAINERS



Roberto Gavioso is a senior research scientist at INRiM, the National Metrological Institute of Italy, where he currently leads the Temperature Metrology Group. His research activities are focused on the application of acoustic and microwave techniques to the development of temperature, pressure and humidity measurements and standards. He is a member of the Working Group for Contact Thermometry (WG-CTh) of the Consultative Committee on Thermometry (CCT) of the Bureau International des Poids et Mesures (BIPM). He is a Lecturer in Physical Acoustics at the University of

Torino.

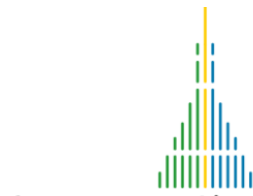


Giovanni Durando after his PhD in Metrology, worked for more than 15 years at the INRiM Istituto Nazionale di Ricerca Metrologica. He is the head of the Ultrasound Laboratory, responsible for the quality of its work and providing strategic leadership. He is member of IEC TC 87 “Ultrasonics”, chair of the Italian committee CEI TC29/87, convenor of TC AUV sub-committee “Ultrasound and Underwater Acoustic” and Italian delegate for CCAUV (Consultative Committee for Acoustic, Ultrasound and Vibration). His research

focuses on the characterisation of ultrasound field used in biomedical experiments. He is coordinator of EURAMET EMPIR 18HLT06 RaChy Radiotherapy Coupled with Hyperthermia project.



Fabio Saba received the PhD degree in Energetics from the Politecnico di Torino in 2017. He currently works as a researcher at INRiM, the National Institute of Metrological Research of Italy, where he is responsible for the calibration activities of the Sound-in-air Laboratory, which provides the metrological traceability of acoustic measurements to the national standard of acoustic pressure. He is a member of the Working Group for “Measurement microphones” (WG 5) of IEC TC 29 “Electroacoustics”. His main research fields concern the study of primary standards for acoustic pressure, and the



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metrological characterization of MEMS microphones.



Alessandro Schiavi is researcher at the National Institute of Metrological Research (INRIM, Italy). MSc degree in Physics, he is responsible for Vibrations, primary and secondary standard calibration. He is nominated expert within the Consultative Committee for Acoustics, Ultrasound and Vibration of the Bureau International des Poids et Mesures (BIPM, Sevrès); member of the Technical Committee “Vibration Measurement” of the International Measurement Confederation (IMEKO); member of the Technical Committee for Acoustics, Ultrasound and Vibration of European Association of National Metrology Institutes (EURAMET); member of board of the Acoustical Society of Italy (AIA).

He is Adjunct Professor at Politecnico di Torino: Noise control Engineering. His main research fields are vibrations fundamental metrology, environmental and mechanical vibrations, structural acoustics, mechanical and physical properties of materials.



Laura Rossi is a multidisciplinary professional. During the last 15 years, she developed several skills in different domains always trying to generate innovative interpenetration. She currently manages several projects in the framework of Industry 4.0 concerning the manufacturing processes of different industries (automotive, railway, aerospace, white industry, food&beverage and energy). She is interested in developing key expertise on the use of virtual and augmented reality for workplace design, ergonomics and training. As Ph.D in Metrology, she is interested in the evolution of measurements

techniques in terms of both instrumentation and methods. Given her humanistic background with a master degree in Philosophy of Science, she has also been particularly interested in the metrology of human perception, sensory and quality research.

