## F34 Should Forensic Science Rely on Opinions or Factual Data? The Role of Forensic Metrology

*Alessandro M. Ferrero, MSc, Politecnico di Milano, DEIB, Milano 20133, ITALY; Veronica Scotti, LLM*, Politecnico Di Milano, DEIB, Milano 20133, ITALY*

**Learning Overview:** After attending this presentation, attendees will better understand the role played by forensic metrology in changing an opinion, including competent opinions based on scientific data, into a set of factual data within which the information we are looking for lies with a given probability.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by increasing awareness of the manner in which expert testimonies aimed at reporting on experimental tests (i.e., fingerprint comparisons, DNA comparisons, exceeded thresholds, etc.) become more complete and informative if reported in a metrologically sound way, including the evaluation of measurement uncertainty.

Despite the emphasis given by the 2009 National Academy of Sciences (NAS) Report and the 2016 President's Council of Advisors on Science and Technology (PCAST) report to the need for scientifically validated forensic methods, it is still common to refer to forensic-science *opinions*, even when the expert witnesses are reporting the results of experimental tests or activities.[1-3]

The PCAST report clearly emphasizes the demand that the scientific validity of forensic science methods is assessed before these same methods can be considered in courtrooms.[2] In other words, forensic methods should provide scientifically validated data, not opinions. The report also provides indications on how to assess this validity through the definition of the *foundational validity* and the *validity as applied*, but unfortunately, it fails to show how such terms can be quantitatively evaluated.

Probability is generally considered to provide such a quantification or, at least, through the evaluation of suitable *likelihood ratios*, provide a quantitative way to assess which one, between two hypotheses, is the most probable.[3]

The major drawback is that probability may not provide an undoubtable answer in all specific situations (Does this fingerprint belong to the defendant? Does this DNA pattern belong to the suspect?), since it is generally evaluated on available databases and does not consider the employed instruments, the influence quantities, the operator, and other variables.

This presentation seeks to show how metrology can overcome this potential drawback, since the good measurement practice does consider all possible contributions to uncertainty, from the *definitional* contribution that quantifies the foundational validity to the many instrumental contributions that quantify the validity as applied.[4]

The result is still a probability, or better, a standard deviation (standard uncertainty) that yields an interval of possible values, built about the measured value, within which the unknown true value of the quantity subject to measurement is supposed to lie with a given coverage probability.[5]

It will also be shown how, starting from such a coverage interval, it is still possible to evaluate a likelihood ratio, if needed, which is now based on specific data related to the considered measurement or test and is supposed to be more reliable in helping the trier of fact render a fair decision beyond any reasonable doubt.

**Reference(s):**

1. National Research Council (NRC), Committee on Identifying the Needs of the Forensic Science Community. (2009). *Strengthening Forensic Science in the United States: A Path Forward*. Washington, DC: The National Academies Press.
2. President's Council of Advisors on Science and Technology (PCAST). *Report to the President: Forensic Science in Criminal Courts: Ensuring Scientific Validity Of Feature-Comparison Methods.* (2016). Washington, DC: Executive Office of the President of the United States.
3. Thomson, William C., Vuille Joelle, Taroni Franco and Biedermann Alex. After Uniqueness: The Evolution of Forensic-Science Opinions. *Judicature*, 102, n. 1 (2018), 18-27.
4. Ferrero, Alessandro and Scotti, Veronica. An Interpretation of the 2016 PCAST Document in Terms of Forensic Metrology. *Proceedings of the American Academy of Forensic Sciences*, 70th Annual Scientific Meeting, Seattle, WA. 2018. 581.
5. *International vocabulary of metrology: basic and general concepts and associated terms (VIM) = Vocabulaire international de métrologie: concepts fondamentaux et généraux et termes associés. (VIM)* (Geneva: ISO, 2007).

**Opinions, Data, Uncertainty**