Practical Ideas from Professors: Standards Education in Your Courses

# Teaching Standards in Electromagnetics & Communication

CentraleSupélec

## The Engineering Program at CentraleSupélec

In 2010 the Department of Electromagnetics of Supélec (CentraleSupélec since 2015), a Grande Ecole graduate school of engineering located in the Île-de-France region of France, successfully implemented a graduate course entitled Human Exposure and Electromagnetic Field Measurement. This course, which is proposed within the Electromagnetics and Communication program, is taken during the last year of the 3-year engineering curriculum.

## Program Details:

The aim of the Human Exposure and Electromagnetic Field Measurement course is to provide a sound knowledge of: the problem of human exposure to electromagnetic fields, the currently applied standards and exposure limits, and the methodology for the evaluation of the exposure. It appeared natural to incorporate international guidelines, recommendations and standards related to electromagnetic field exposure in this course.

Prof. Vikass Monebhurrun

Professor Vikass Monebhurrun has been actively participating in French National Research Programs on dosimetry since 1998. His research has contributed to the international standardization committees of CENELEC, IEC, and IEEE. He is author or co-author of about 100 peer-reviewed conference and journal papers and he holds three international patents on antennas for mobile communications. He actively participates in several international standardization committees on numerical and experimental dosimetry, namely IEEE 1528™, IEC 62209, IEC 62232, and IEEE/IEC 62704. He currently chairs the IEEE Antennas and Propagation Standards Committee as well as the IEEE/IEC 62704-3 Standardization Committee.

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## Using Standards in Electromagnetics and Communication

The course starts with an introduction to commonly encountered wireless communication systems and standards, e.g., IEEE 802.11™. Following a historical review of how the problem of electromagnetic field exposure was addressed in different countries—dating back to the use of radars by the military during World War II—the need for a consensus-based document, i.e., a standard, elaborated by a committee of recognized experts is demonstrated. One of the references for the definition of the electromagnetic field exposure limits is IEEE C95.1™. There are also references to similar documents proposed by other national or international committees to emphasize the importance of developing harmonized standards to ensure worldwide acceptance.

Once the exposure limits are defined, the standards applied to demonstrate product compliance—prior to the marketing of the handsets and the installations of the base station antennas—are presented. For example, the measurement procedure for the Specific Absorption Rate (SAR) evaluation of handsets, as described in IEEE 1528™, is detailed. As an application example, the step-by-step design of a mobile phone is considered: it is verified that the prototype mobile phone complies with both performance and SAR standards. The students further learn that if a standardized measurement procedure is enforced, it guarantees that the results can be replicated by another test laboratory, within a given measurement uncertainty. Since a standard dosimetric test facility is also available in the laboratory, the students can follow a demonstration of the measurement procedure used to show the SAR compliance of a mobile phone.

Since there are multiple bodies—national as well as international—developing standards for different electrical engineering applications, it is expected that, following this course, the student is able to find the right standard for a given purpose once he/she starts to work as a professional engineer.