



## **Teaching EM Measurement Techniques within an On-Line Environment**

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On-line learning is rapidly becoming the preferred method working professionals use when seeking a graduate degree. The hands-on experience usually gained in labs is greatly diminished as students are expected to gain knowledge from their classes without the use of the lab facilities. As such, various methods of teaching EM measurement techniques need to be developed and implemented to replace the hands-on lab experience as much as possible using on-line techniques.

As education trends to more and more to online offerings, the challenge of imparting equivalent laboratory experience can be developed using a variety of methods. This presentation will outline some methods that can be used to teach EM measurements. In particular, the commonly used Blackboard software environment will be discussed such as: active computer simulations, in-person videos, and virtual labs.

Computer simulations can be a valuable resource for displaying electromagnetic fields. For example, the fields in coaxial cables, waveguides, and the radiated fields of antennas are easily simulated in the form of short videos showing their behavior over time. In-person videos are another tool that can be used to compliment and explain the computer simulations as well as establishing a more personal link between the student and the professor. Simply showing RF components and how they are used in various systems instill physical meaning to the importance of measurements that characterize the behavior of RF components. Finally, using a laptop, a student may participate in virtual labs to further enhance the education of EM measurements. Such a lab will be outlined and discussed.