



From the Editor's Desk

Microwave Measurements Come to the Fore

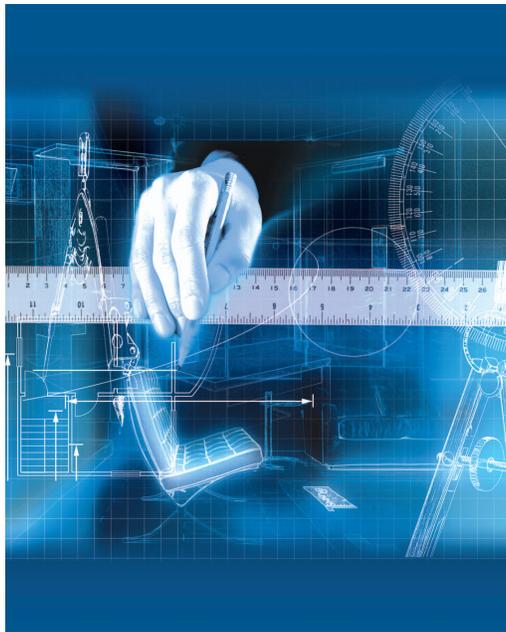
■ **Kate A. Remley and Charles Wilker**

In today's world of highly integrated electronics, microwave measurements have become critical in the design of electronic components and systems. "Measurement-based model" and "measurement-based design" are common terms that describe the direct incorporation of measured data as part of the design flow. As industry squeezes more devices into circuits that operate at higher frequencies and power levels, existing, emerging, and new technologies are being pushed to their limits. In the process, we are finding that the physics is not so straightforward—be it the design for a simple component, a complex device, a functional chip, a packaged subsystem, or an entire system.

Measurements are coming to the rescue to save time and money in the development of models by enabling designers to predict complex component behavior without having to understand every physical interaction in

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detail. As an example, design iterations for system-on-a-chip modules used in cell phones are exceptionally expensive. For these high levels of integration, models need to account for both inter- and intra-device interactions. Trustworthy measurement-based and measurement-verified models are critically needed to save time and avoid expensive redesign.

While this situation should give those of us in the measurement commu-

nity cause for celebration, we still often face an uphill battle. Measurements are not glamorous, or so conventional engineering thinking goes. Instead of being integrated into the design team up front, measurements are often brought in as an afterthought, much as our historically common contribution of verification has been treated.

Fortunately, organizations exist in which members of the microwave measurement community can meet to discuss new ideas, compare notes, communicate techniques, and generally find inspiration in the company of like-minded individuals. Two such groups are the IEEE Technical Committee on Microwave Measurements (MTT-11) and the Automatic RF Techniques Group (ARFTG). Both of these organizations are devoted to bringing to light the newest techniques in microwave measurement, sharing insights, and providing educational services to the general RF and microwave communities. These two groups share a common mission and vision yet provide unique services to the microwave community.

MTT-11 is one of the technical committees of the IEEE Microwave Theory and Techniques Society (MTT-S). The

membership consists of engineers who have devoted their careers to measurements, have contributed to the body of knowledge on the subject, and who are interested in bettering the state of microwave measurements by sharing their expertise with other MTT-S members. We currently have 32 members, with each member involved in a different activity designed to serve the microwave measurement community. We encourage you to visit our Web site at <http://mtt.org/committees/mtt-11/index.html> to take a look at these various projects.

Some of MTT-11's current activities include:

- Web-based discussion forums on a range of measurement topics moderated by committee members.
- Review and sponsorship of relevant workshops for the MTT-S's International Microwave Symposium (IMS). Past workshop slides are often posted on the Web site for MTT-S members.
- Sponsorship of the "Creativity and Originality in Microwave Measurements" contest (see our Web site).
- Nomination of candidates for Distinguished Microwave Lecturer. Past successful nominees include Doug Rytting of Agilent Technologies, on "Calibration and Error Correction Techniques for Network Analysis," and, in 2007, Paul Tasker from the University of Cardiff, on "Engineering and Measuring RF Waveforms—the Unifying Link Between System Performance, Circuit Design and Transistor Technology."
- Posting "milestone papers" on a variety of measurement-related topics on the Web site. Since "milestone" is a fluid and subjective term, the papers chosen will continue to evolve and change over the years.

A history of the vector network analyzer provides insight into the importance of calibration for this commonly used instrument, and how the calibrations have evolved in their current, seemingly confusing, form.

- We are investigating whether a knowledge database based on the Wikipedia Web site idea is feasible. We envision definitions of key terms such as "intermodulation distortion" by members and lists of bibliographic references that could be used to educate readers on these topics. Again, this would be an ever-evolving and growing project.

Another important group focusing on the measurement needs of the microwave community is ARFTG, organized in 1972 as a vector-network-analyzer users' group. Like MTT-S, ARFTG is a community that brings together colleagues, experts, and vendors with a particular focus on RF and microwave test and measurement. ARFTG is not a part of IEEE but an independent, international, nonprofit technical organization. Like MTT-S, ARFTG is a volunteer-run organization, operated exclusively for scientific and

educational purposes. ARFTG membership includes a broad mix of government metrologists, academic researchers, and industrial practitioners. Like MTT-S, ARFTG provides a forum for the development of new technologies, methodologies, and instrumentation. We invite you to visit our Web site at www.arftg.org for more information. Highlights from current ARFTG activities include:

- two technical conferences held each year, one on the Friday of the International Microwave Symposium week and the other separately during the fall
- a student fellowship to fund research into microwave measurements for promising university students (see the "Education News" column in this issue)
- a nonlinear measurements workshop held during the fall conference to highlight the state of the art in this complicated measurement arena

- the Nonlinear Vector Network Analyzer Users' Forum, an informal discussion group devoted to sharing information and issues related to instrumentation utilized in vector large-signal network analysis of microwave circuits and systems that contain nonlinear elements (see article on the forum and the nonlinear measurement workshop in the August 2007 issue of *IEEE Microwave Magazine*)
- a measurement comparison program to help laboratories assess the certainty (or, just as importantly, the uncertainty) of its measurements (see the article on this topic in the August 2007 issue of *IEEE Microwave Magazine*)
- sponsorship of workshops at the IEEE International Microwave Symposium each June.

As you can see, educational activities are high priorities for both ARFTG and MTT-11, and *IEEE Microwave Magazine* is an ideal outlet for bringing a better understanding of measurements to the general microwave community. This is the second focused issue of *IEEE Microwave Magazine* that is jointly sponsored by ARFTG and MTT-11. The first was the August 2007 issue.

In this issue, we highlight some of the state-of-the-art developments in microwave measurements as well as some of the history that has brought us to this point in time. Articles on measurement-based design of power amplifiers, measurements for signal integrity in IC design, use of multi-sine signals for design and verification of wireless components, as well as test and verification of lightwave components, fit the former category. A history of the vector network analyzer provides insight into the importance of calibration for this commonly used instrument, and how the calibrations have evolved in their current, seemingly confusing, form. We invite you to peruse these articles and send comments or questions to the authors. Our common goal is to make measurements readily accessible, easily understandable, ubiquitous, and thus an important part in the everyday microwave design process!

