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Research Brings Great Ideas to the Real World

Gary Breed
Editorial Director

This issue's Technology Report offers an all-too-brief snapshot of the research topics being pursued in industry and at universities. I am a big fan of engineers and scientists who are driven by creativity and willing to do the hard work necessary to bring creative ideas to fruition, so this report was both fascinating in its content and frustrating in its brevity.

It's not that we short-changed the topic—two pages isn't much, but a whole issue would still not be enough space to provide a complete picture of the many different concepts being studied for potential future products and systems. One of the regular publications I receive is the *IEEE Transactions on Antennas and Propagation*. Each monthly volume has 250-400 pages (!) of papers covering every conceivable topic on antennas and radiowave propagation—some recognizable topics include smart antennas, mm-wave antennas, miniaturized antennas, and ongoing mathematical contributions to analysis and modeling. Among the less-well-known subjects described in recent volumes are ocean wave scattering of GPS signals, superresolution radar imagery, and optimization using "particle swarm," "ant colony," and "genetic" algorithms. And that's just one journal covering one specialty.

Research has three distinct types—specific product/system development, incremental improvements to basic understanding, and completely new concepts. The first of these takes place both in industry laboratories and as a significant part of industry-sponsored university research. This important type of research typically seeks to find a way to accomplish a task that is (more or less) known to have a solution. The question answered is, "What does it take to do make this work?" Current work of this type includes network management and optimization, miniature antennas, software-defined radio, mm-wave techniques, and other matters that are necessary to keep current technology moving ahead.

The second type of research—incremental steps advancing basic understanding—is a staple of university graduate school research. Occasionally, this type of research is criticized as "make work" graduate study. This may have been the case in the past, but there are so many timely subjects to explore that a new contribution in any one of them is valuable and appreciated. History is full of seemingly minor research footnotes that ultimately became keys to major breakthroughs.

Of course, the futuristic "big picture" type of research is the most glamorous, often getting lots of attention in the public media. Because of this, subjects like genetic modification and cloning are familiar to even the most unscientific members of the public.

More often, new concepts are less visible, at least until they become revolutionary products. In the 1970s, the concept of a cellular network structure was as advanced as any other research subject.

Moore's law may be a good predictor of the growth in computing power, but pioneering propagation and modulation research in the 1980s gave this computing power the freedom of practical wireless networks in the radio-unfriendly indoor environment.

Today's new frontiers are microscopic and macroscopic—from implantable RFID tags and ingestible sensors, to self-optimizing large-scale wireless networks. When you add other new areas like sensors and nanotechnology, it's easy to see how researchers can get excited about their work!

Coming in Future Issues:

Issue	Tutorial Topic	Technology Report	Product Coverage
July/August	Noise Measurement	EMC Standards	Wireless Modules Coax Cable
September	Balanced Circuits	Semiconductor Materials	Amplifiers Test Accessories
October	Optical Detectors and Preamps	Baseband DSP	EMI Control Manufacturing

Turning Ideas into Products

The best research isn't much good if it can't be implemented. The fundamental work on I-Q modulation and demodulation was done in the 1940s and early 1950s, but the available components and test methods were not sufficiently precise to make I-Q systems with adequate performance. So, alternative methods were developed and used until the technology caught up with the science.

The development process often works that way, not only for technical reasons, but in response to marketplace forces—Does anyone really need this product? Can those who want it afford to buy it?

Then we ask, "What additional work is needed to get the answer 'Yes!' to those questions?"

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