From the Editor's Desk

Is Microwave Engineering a "Mature" Field?

■ **Madhu S. Gupta**

As we approach the International Microwave Symposium (IMS) and Microwave Week, some will ask if attendance is worthwhile. I sometimes hear from attendees of various microwave conferences that "there was little that was new," usually with the explanation that this is "as expected in a mature field." On cross examination, I typically learn that the proclaimed lack of novelty is not a considered judgment based on the actual technical contents of the conference, but rather the commentator's expectation from a field once it been labeled "mature."

Is microwave engineering really a mature discipline and, if so, in what sense? Depending on its definition, "maturity" can have either a pejorative or an admirable connotation for a discipline. On the one hand, maturity may imply cessation of further development; on the other hand, it recognizes crossing the stage of indefiniteness to reach a recognized, well-established existence. Although the MTT-S celebrated its 50th anniversary recently, the number of years a field has been around—unlike for humans—is not indicative of its maturity.

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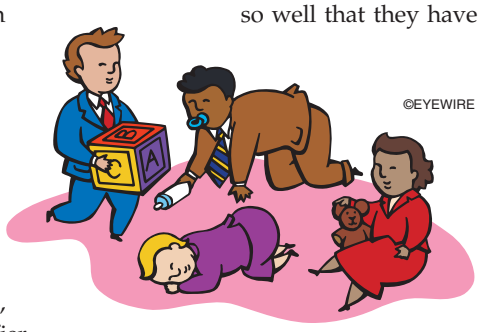
One sign of a mature field is a slowing down of the rate of progress in the field to a trickle. That this is far from the case in the microwave field is easily established by perusing the new product announcements, journal articles, and doctoral theses in the microwave area (although the latter could well be illusory—the number of theses written each year on William Shakespeare is a tell-tale sign). Another indicator of a discipline's maturity might be that the new developments in it are minor and incremental in nature. In the microwave field, such a notion is quickly dispelled by numerous counter examples: e.g., rapidly advancing performance of SiGe and GaN chips, the striking impact of power amplifier linearization on wireless communication, and others. Still another sign of maturity for a discipline could be its reduced attractiveness to new entrants, so that the average age of its practitioners increases by almost a year each year; by contrast, the microwave profession continues to attract large numbers of new young members, as can be verified by a visit to the IMS or a glimpse at the authorship of articles in the journals of the field.

So why the lingering perception of "maturity" among professionals who should know better? I believe the sense in which the microwave field has matured is very different. In our field, the basic principles have been laid down for some time, and Maxwell's equations have not needed any modification for a century and a half (or, at least for a century since Heaviside wrote them in the presently employed form). Moreover, the mathematical models work so well that they have displaced empirical methods in large part; one consequence is that much of microwave engineering education is no longer based on hands-on apprenticeship. Furthermore, large segments of the knowledge in the discipline have been consolidated in books and have become relatively standardized, as has the teaching of new microwave engineers—the textbooks in the field all say roughly the same thing in roughly the same order.



A bulk of the new work in the microwave field applies established theory to new contexts, applications, and

businesses. Most of the novelty is, therefore, in applications. More importantly, new breakthroughs continue to occur that stir a great deal of excitement. Admittedly, the higher the threshold of criterion for defining a "breakthrough," the less frequently it happens. I fondly remember the excitement accompanying the commercial availability of electromagnetic simulation software at the beginning of 1990s that led to packed, standing-room only sessions at meetings and workshops. It was similar to the frenzy that was created in the physics community in the late 1980s by the discovery of high-temperature superconductors.

Of course, we expect our field to continue to be invigorated by future breakthroughs of various magnitudes, ranging up to the level of events like the birth of lasers that rejuvenated optical physics after decades of "maturity." It's just that the breakthroughs cannot be anticipated, much less scheduled to occur like clockwork, as some managers seem to want. But when those breakthroughs do occur, you can be sure they will get presented at the major conferences of the discipline.