Guest Editor's Overview

THIS Mini-Special Issue of the IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES contains selected extended papers that were presented in a more reduced form at the 1997 Topical Symposium on Millimeter Waves (TSMMW'97), held in Shonan Village Center, Hayama, Japan, July 7-8, 1997. Our Organizer-in-Chief was Prof. Tatsuo Itoh, University of California at Los Angeles (UCLA), who grew up in a village near the conference center. The people in the local villages were very friendly and helpful. We all thank Tatsuo and the other members of the steering committee located in Japan, who showed us a very charming part of a wonderful country. I want to thank all the people who participated in reviewing and editing this Mini-Special Issue. I especially want to thank Prof. James W. Mink, who gave me a lot of direct editing help, despite his very time-consuming job as the Editor-in-Chief of this TRANSACTIONS.

Members of the steering committee and reviewers are as follows:

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Special mention should be made of Dr. Horst Wittmann, USAF Rome Laboratory, Hanscom AFB, MA, who initiated this whole project, but was then unable to attend. We missed him. Finally, I want to thank our Japanese colleagues, both authors and reviewers, for their extraordinary effort to be precisely punctual, despite short suspenses and their geographical location.

The papers in this section are arranged according to one person's opinion of their generality. Overview papers and papers with broad perspective are first, followed by papers dealing with specific techniques with broad application, and finally, papers dealing with specific applications or specific circuits. Short papers appear last.

The first five papers are overview in nature. The first two are expanded versions of the keynote addresses at the workshop. The Yoneyama paper describes the Japanese research in millimeter-wave techniques. He also makes the interesting observation that the fraction of millimeter-wave papers, as a percentage of the total number of microwave papers, presented at the annual IEICE symposium in Japan is twice the corresponding fraction for the annual IEEE MTT-S symposium in the U.S. It is possible to draw the conclusion that perhaps the microwave research in Japan is more heavily concentrated on millimeter-wave issues than it is in the U.S. The Greiling and Ho paper presents an overview of cutting-edge technology for satellite communications, particularly new device technologies. The Eisele and Haddad paper reviews the state-of-the-art of two-terminal devices. This is a useful paper because in recent years there has been relatively few technical references on two-terminal devices even though substantial progress has been made, with correspondingly rare review papers written on the subject. The Gupta paper is an excellent review paper on new approaches for electromagnetic (EM) simulation and computer-aided design (CAD) of millimeter-wave structures, especially the discussion of diakoptics. Diakoptics, or methods to divide and conquer complex EM structures, will be absolutely necessary to successfully model EM structures of many wavelengths, especially when nonlinear devices and circuits are components of the overall structure. The Mishra *et al.* paper reviews the field of GaN microwave devices and circuits, and also presents some exciting new results.

The following seven papers discuss innovative techniques for millimeter-wave circuit integration. The Herrick *et al.* paper describes micromachined coplanar waveguides for use in millimeter-wave circuits. These waveguides are components for an exciting new planar integration technology based on silicon micromachining, which uses flip-chip integrated circuits (IC's) of III–V active devices into connecting microchannels in silicon, which shield and self-package the overall circuit. With this technology, it is possible to approach metallic-waveguide performance with a planar circuit geometry. High-Q cavities and filters can be readily constructed. Very high RF circuit densities are possible. Three-dimensional layered

circuit integration has been demonstrated, and the circuits are significantly less expensive than comparable commercial components. The Liu *et al.*, Perkons *et al.*, and Hicks *et al.* papers discuss key issues in the use of quasi-optical circuit-combining techniques, which perform circuit functions on a wave field in free space, rather than on signals traveling sequentially along transmission lines between circuit components. Quasi-optical and spatial-combining techniques have the potential to reduce losses and increase functionality, replacing very complex planar or waveguide circuits with simpler components operating on the transmitted EM field. The Liu *et al.* paper discusses an important newly formulated theory of stability in amplifier grids, which perform EM power combining in three-dimensional free space. The following two papers describe an alternative architecture in which power combining is done in the EM field propagating in a dielectric substrate with a thickness less than a wavelength. The Ando *et al.* and Kobayashi and Yasuoka papers describe novel flat antenna structures with high efficiency for integration with millimeter-wave IC's. The Kuroki *et al.* paper discusses a specific transceiver circuit application based on an innovative integration with nonradiating dielectric waveguide.

The remainder of this TRANSACTION's papers deal with innovative approaches for specific applications. In particular, the Hayashi *et al.* paper describes novel amplifier and mixer monolithic microwave integrated circuits (MMIC's), which use 45° power divider/combiner circuit elements to eliminate unwanted signal components. Lastly, the Hoshi *et al.* paper describes an entirely new application for millimeter waves for dental diagnosis and treatment. Although this paper concentrates on diagnosis issues, the demonstrated absorption by dental caries of millimeter-wave power points the way to a new tool to replace drilling in dental treatment.

I would like to thank and congratulate all the speakers and authors who contributed to making the symposium and this Mini-Special Issue a success.

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James F. Harvey (M'91) received the B.S. degree in engineering from the U.S. Military Academy, West Point, NY, in 1964, the M.A. degree in physics from Dartmouth College, Hanover, NH, in 1972, and the Ph.D. degree in applied science from the University of California at Davis, in 1990, with research performed at Lawrence Livermore National Laboratory, Livermore, CA.

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