Guest Editorial

THE MOST dramatic advances today in electronics are in very high speed (picosecond) circuits and in photonics. The extensive effort in monolithic microwave integrated circuits (MMIC's) will have a profound effect on high-speed, high-frequency analog and digital components and systems. Rapid progress in photonics and associated lightwave technologies, such as fiber optics, image processing, and high-speed parallel computing, are already making a significant impact in communications, surveillance, computer networking, office and factory automation, and medicine. The interface between these two major areas, lightwave and microwave technologies, is therefore a growing area of interest. Consequently, this special joint issue of the IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES and the JOURNAL OF LIGHTWAVE TECHNOLOGY is devoted to *Applications of Lightwave Technology to Microwave Devices, Circuits, and Systems*.

That approximately 50 papers, originating in five continents, were considered for publication offers a vivid testimony to the vitality of optical–microwave interaction research. These contributions, from universities, government, and industrial research laboratories, proved to be of high quality and great diversity. My sincere thanks go to the scientists and engineers whose contributions made this special issue possible and to the reviewers, whose labors are greatly appreciated. Also, I wish to thank Chi Lee and Norm Dietrich for their helpful suggestions, and Rodney Tucker, Editor of this TRANSACTIONS, for his ready willingness to offer advice and support.

The articles fall into two general categories: 1) distribution of analog microwave signals via high-speed fiber-optic links and 2) optically controlled microwave devices and circuits. The first of these categories deals with topics related to the use of fiber-optic cables to route microwave signals, which represents an attractive alternative to conventional coaxial cables and waveguide transmission media. The replacement of the metallic transmission system with a fiber-optic network reduces size and weight and provides larger bandwidth, immunity to interference (EMI and EMP), excellent crosstalk isolation, and potentially smaller transmission losses, particularly at higher frequencies. Applications include antenna remoting, feed networks for phased array antennas, delay lines, and cable television signal distribution. This section opens with three invited papers. The first, by A. Daryoush, deals with the optically implemented synchronization of microwave local oscillators which are required, for example, in phased array antennas. The paper by T. Sueta and M. Izutsu provides a review of high-speed integrated optic devices. The third invited paper in this category concerns the application of fiber optics to cable television. The most important problem with high-speed fiber-optic links is the interface between the optical and microwave components; most of the ensuing contributed papers address various aspects of this problem.

The second group of papers, also starting with three invited papers, deals with optically controlled devices and circuits. The first review article, by A. J. Seeds and A. A. de Salles, concentrates on optically controlled active microwave devices. Here the optical input can be viewed as an extra (optical) terminal through which its operation can be governed. The invited paper by P. Cheung, D. P. Neikirk, and T. Itoh discusses the optical control of passive microwave elements, such as waveguides, to achieve phase shifts. In the last invited paper, Chi Lee discusses the pioneering work on the application of picosecond optics to microwaves. This technique can be used for measurement and characterization of microwave components as well as for optically triggered microwave power generation.

Just a short time ago, those researchers engaged in merging these two technologies, lightwaves and microwaves, consisted of only a handful of dedicated scientists, whose work was viewed with considerable skepticism. Optically controlled microwave devices and the fiber-optic distribution of microwave signals were considered curious ideas, novelties that could, perhaps some day in the distant future, reach utilization. Instead, fiber-optic delay lines and fiber-optic distribution of television signals are here today, and even such "exotic" concepts as the optically controlled phased array antenna now seem increasingly realizable. The number of investigators and research establishments pursuing research in hybrid optical–microwave systems is rapidly rising; new devices, new techniques, and new applications are continually emerging. We will see chip-level integration of sophisticated electro-optic and microwave components and circuits, as well as the emergence of synthesized optical–microwave systems with enhanced capabilities, such as optical signal processing, leading to new applications. I am confident that the next few years, even the next few months, will bring exciting new results and developments; thus, I look forward with great anticipation to the next special issue on this subject.

PETER R. HERCZFELD
Guest Editor

Peter R. Herczfeld (S'66–M'67–SM'89) was born in Budapest, Hungary, in 1936. A U.S. citizen, he received the B.S. degree in physics from Colorado State University in 1961, and the M.S. degree in physics in 1963 and the Ph.D. degree in electrical engineering in 1967, both from the University of Minnesota. Since 1967 he has been on the faculty of Drexel University, where he is a Professor of Electrical and Computer Engineering.

Dr. Herczfeld has published over 200 articles on microwaves, solid-state electronics, photonics, solar energy, and biomedical engineering. He has served as project director for over 50 sponsored projects. He has taught 20 different courses on the graduate and undergraduate levels and has lectured extensively in the U.S. and in ten other countries. He is the Director of the Center for Microwave–Lightwave Engineering at Drexel.

A member of SPIE, APS, and the ISEC, he has received several research and publication awards, including the European Microwave Prize.