

Guest Editorial

PERIODICALLY, the Technical Committee on Microwave Systems (MTT-16) of the Microwave Theory and Techniques Society (MTT-S) sponsors various types of events to promote the exchange of information on selected aspects of system design. Workshops and panel sessions at International Microwave Symposia (IMS) [1]–[3], together with summaries of their proceedings [4] and special issues of this TRANSACTIONS [5], have been used to provide such a forum.

The present Special Issue is intended to emphasize evolutionary developments in the design and application of microwave systems. Such developments are driven both from internal sources due to technological advances and from external sources as a result of new functional requirements. Advances in semiconductor technologies, particularly in integrated circuit materials and manufacturing techniques, are having a major impact on system architectures and operational capabilities. In the more classic areas of radar and communication systems, the availability of higher device densities has shaped system parameters such as size, performance, operating frequency, and cost. These advances have resulted in the extension of present and the creation of new system applications. The simultaneous evolution of computing techniques has allowed detailed modeling at the device and system levels, resulting in closely controlled designs, and has opened new horizons in system output information processing for military, commercial, industrial, and medical applications.

An earlier special issue of this TRANSACTIONS [6] considered the impact of lightwave technology on microwave applications, with emphasis on device characteristics. These developments have created new types of optical applications, predominantly in the communication systems area. A second special issue [7] was devoted to a discussion of advances in semiconductor device technologies, particularly in the area of multifunction MMIC's, and included some system considerations [8]. Such device improvements strongly impact the partitioning, performance, reliability, and eventual cost of systems, as well as invite the creation of new types of applications. The papers selected for publication in this Special Issue generally represent system design considerations; they demonstrate either presently available performance, based on advanced designs and technologies, or proposed applications which may require further progress in device, manufacturing, system architecture, or signal processing capabilities.

The first group of papers presents a review of advances in millimeter-wave technologies and areas of application in Germany, Japan, and the United Kingdom, as discussed during a panel session at the 1990 IMS [3]. This

group is introduced with a paper by J. B. Horton, the moderator of the panel. Although the special involvements of the authors are emphasized, these papers show significant shifts from military to commercial applications, particularly vehicular technology, worldwide.

The second group of papers covers various aspects of radar and remote sensing applications. Frequency synthesizers are at the center of many system designs; an overview of synthesizer architectures and hardware advances is given, together with some future expectations. This is followed by a paper on clutter removal by designing with the proper architecture and using highly stable hardware. The next two papers require high-speed processing: in the first, critical hardware and special control algorithms interact to achieve adaptive cancellation in the receiver using both feedforward and feedback techniques, while the second paper relies on the evaluation of periodicities in the group delay of returns to allow accurate determination of target distance spacings between two reflections. A complete experimental system is demonstrated in the next paper, which uses a 94 GHz radar to provide robotic "vision" of its immediate environment. The use of microwave energy to determine the moisture content of materials is proposed in the last paper of this group.

The third group of papers discusses medical applications and contains two papers on microwave imaging and one contribution on hyperthermia. To achieve spatial resolution, the first paper uses an array of switched L-band transmit/receive antennas which is arranged cylindrically around the body to obtain multiple views without requiring physical rotation. The second paper shifts the burden from the hardware to the computational problem of finding a mathematical solution to the scattering problem of nonuniform dielectrics. Both papers contain extended bibliographies. The use of appropriately designed horn antennas to obtain more tightly controlled energy distributions inside the body for hyperthermia applications is discussed in the last paper.

The breadth of applications for many of the presently emerging technologies is only slowly appearing in the general or technical literature. From the creation of new device structures, to ever wider bandwidths of optical devices, to ever more highly integrated circuit topologies operating at ever higher frequencies, to ever increasing computational powers of resident microprocessors, exciting prospects face the systems design community. The challenge will continue to be the optimum integration of all available resources in the design, implementation, and application of systems which satisfy present demands or perform new functions.

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George L. Heiter (M'65-SM'83) was born in 1935 in Hannover, Germany. He received his "Vordiplom" and Dipl.Ing. degrees from the Technical Universities of Darmstadt and Karlsruhe, Germany, in 1956 and 1959, respectively, and was granted the Ph.D degree by Stanford University in 1964.

In 1963 he joined AT&T-Bell Laboratories, where he participated in the development of high-power ferrite devices and materials, holographic optical memories, terrestrial microwave radio systems, and transmitters for optical communication links. He has published papers and holds patents in most of these areas. His present involvements include wireless communication systems.

Dr. Heiter is a member of the American Physical Society and of Sigma Xi. Within the Microwave Theory and Techniques Society, he is a member of the editorial board of the TRANSACTIONS, and has been involved in a number of International Microwave Symposia, serving on technical program committees, as session chairman, and as panel organizer and moderator. For the 1991 Symposium, he is a member of the steering committee and the digest editor. He is cochairman of the Technical Committee on Microwave Systems (MTT-16).