Foreword

Special Issue on Microwave Acoustic Signal Processing

OUR GOAL in preparing this G-MTT/SU Special Issue is to highlight recent progress in research and development of microwave acoustic devices that perform signal-processing operations. The composition of this issue reflects the current research emphasis on surface acoustic wave devices; the papers presented here are largely concerned with surface-wave devices and their signal-processing applications.

Historically, devices that employ volume acoustic waves have found important applications in frequency control, filters, and data storage. In contrast, the recent emergence of surface acoustic wave devices may be compared to the development of the transistor from its earlier alloyed junction form to the microelectronic integrated circuit in use today. The versatility and microelectronic size of surface-wave devices promises not only to give them wide application in the traditional signal-processing functions mentioned above, but also in new areas such as the generation and correlation of complex coded signals. Engineers and system designers alike will find interest in the wide variety of signal-processing functions available with these devices. The ability of surface-wave devices to perform complex operations in surprisingly compact and simple configurations is likely to play an important role in future radar and communication systems.

The issue is organized into three areas: filters, general signal-processing components, and spread spectrum devices. The first four papers illustrate the outstanding performance obtained recently by acoustic filters operating in the VHF frequency range. The first paper reviews the design of microelectronic surface-wave bandpass filters and demonstrates that these filters are now capable of bandwidths smaller than 1 percent, insertion loss less than 10 dB, and frequency sidelobe rejection in excess of 50 dB. The next three papers describe volume and surface-wave dispersive filters that have been developed for high compression ratio radar systems. These devices have already achieved time–bandwidth products of 1000 or more and in some cases appear extendable to products approaching 10 000.

The second group of papers illustrates the wide variety of signal-processing operations available with acoustic devices operating at VHF and microwave frequencies. Papers exploring the multistrip coupler and topological acoustic waveguides show that these devices can provide basic building blocks for constructing complex acoustic circuits. The 1280-bit surface-wave memory described here extends the high bit-rate capability of delay-line memories to 220 MHz. A new dimension in acoustic signal processing has recently been demonstrated by nonlinear delay-line devices that use parametric wave interaction to perform convolution or correlation of two arbitrary input signals. Current progress in these devices is reviewed here and many signal-processing illustrations are given. The recently disclosed electron-beam surface-wave device is also reviewed and potential applications described in signal storage, spectrum analysis, and electronically variable time delay.

Perhaps the fastest growing area of surface-wave-device development is the application of these devices to spread spectrum communication systems. The papers in the third part of this issue review the basic definitions of spread spectrum systems in the light of surface-wave technology, give an example of a surface-wave device that can perform radar ranging and digital transmission simultaneously, describe the technology being developed for programmable spread spectrum matched filters, and give an in-depth report on the potential applications of surface-wave technology in future air traffic control systems. The theme developed in these papers is that surface-wave devices can provide economical implementation of spread spectrum modems in a format that is reliable, relatively simple, and is compatible with the integrated circuits that are likely to form the body of the spread spectrum systems.

It was gratifying to this Guest Editor to receive enthusiastic support from authors all over the world. However, many more papers were received than could be accommodated within the liberal, but limited, Special Issue publication budget. We trust that many of the good acoustic-device papers that could not be included here will appear shortly in the literature.

Finally, it is my pleasure to acknowledge the efforts of the many people who made this Special Issue possible. The authors did a marvelous job of adapting papers to the common signal-processing theme, and the reviewers made many helpful suggestions. A. J. Bahr, F. J. Rosenbaum, R. H. Tancrell, and S. Wanuga provided much editorial advice and helpful discussion. Special thanks go to Mrs. Barbara Briere who applied considerable secretarial skills to deal with the small mountain of Special Issue correspondence.

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Guest Editor

Thomas M. Reeder was born in Elmhurst, Ill., on April 17, 1938. He received the B.S.E.E. degree from the University of Illinois, Urbana, in 1960, and the M.S. and Ph.D. degrees, both in electrical engineering, from Stanford University, Stanford, Calif., in 1961 and 1965, respectively.

In 1965 he joined the Standard Telecommunications Laboratories in Harlow, England, where he set up facilities for research on microwave acoustic delay lines. Upon returning to the United States in 1967, he worked on broad-band delay-line coupling networks at Teledyne MEC in Palo Alto, Calif. Between 1968 and 1971 he was a Research Associate at Stanford University Microwave Laboratory, where he carried out research on surface acoustic wave transducers and amplifiers. In 1971 he joined United Aircraft Research Laboratories, East Hartford, Conn., as a Research Scientist. His present research concerns the application of acoustic wave devices in high data-rate signal-processing systems.

Dr. Reeder is a member of Tau Beta Pi, Eta Kappa Nu, Phi Eta Sigma, and the IEEE Groups on Microwave Theory and Techniques and Sonics and Ultrasonics. He is presently Chairman of the G-MTT Technical Committee on Microwave Acoustics.