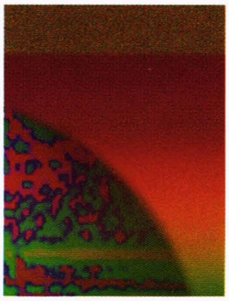


Advanced Sensors: Guest Editors' Introduction

Wayne A. Bryden and Joseph J. Suter

As defined by Webster's dictionary, sensors are devices that "respond to a physical stimulus and transmit a resulting impulse." As such, they are the eyes, ears, and other sensory inputs to measurement and control systems for an entire spectrum of applications, touching a majority of the programs at APL. Although this issue of the *Technical Digest* features solicited articles on advanced sensor development, we could never hope to cover the entire topic in a single journal issue. We aimed to feature a representative set of sensor developments at the Laboratory and to do it in such a way that the reader would learn of the efforts at APL from the exploratory stages all the way to operational sensor systems. The articles in this issue feature the measurement of acoustic, magnetic, optical (ultraviolet, visible, and infrared), and chemical information. In addition, one article reports on the emerging field of sensors based on microelectromechanical systems that can measure, on a microscale, a broad range of physical properties.

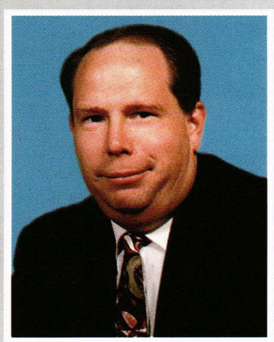
In this issue, two articles provide examples of advanced-operation sensor systems. First, in the article by Allensworth et al., a new twinline towed acoustic sensor array is shown to have improved detection performance in the littoral/shallow water environment, where the detection of enemy diesel/electric submarines is becoming increasingly important. Then, in the article by Zanetti and Potemra, experimental results are presented for the APL-built Magnetic Field Instrument, which is flying on the Swedish Freja scientific satellite. The Magnetic Field Instrument has established that an ionospheric current system associated with the aurora borealis and aurora australis correlates with induced currents in the electric power grid at Chalk Point, Maryland.

For many applications, optical information is of prime importance since it can be used to localize objects and to gain information regarding their physical state. In this issue, three articles focus on optical sensors. First, Wickenden et al. describe an ultraviolet-band missile seeker development based on wide bandgap semiconductor detectors. This type of device has many advantages over infrared seekers for intercontinental or theater ballistic missiles in that ultraviolet emissions are more localized to the hard body, less background interference occurs, and no active window cooling is required for fast-moving airborne systems. Then, Thompson, Rust, and Chen present a polarization imager based on a charge-coupled device detector. This Integrated Dual Imaging Detector uses a polarizing beamsplitter bonded to the charge-coupled device to produce a two-polarization plane image capable of simultaneously analyzing the polarization of light at all elements of the picture scene. Finally, Spicer and Osiander present significant advances in the application of time-resolved infrared radiometry as a sensing method for the evaluation of materials in a completely nondestructive and noncontacting manner. This method has an important application in process monitoring during manufacture as well as in the inspection of structures in service. New thermal excitation sources and detection methods are presented as well as novel concepts for embedded sensors.

The next two articles present concepts for portable detection systems for chemical and biological materials. First, the article by Suter et al. discusses the initial development of a mass loading sensor for trichloroethylene vapor based on an aluminum nitride surface acoustic wave resonator. The initial prototype of this device operates at 267 MHz and is expected to show high sensitivity and specificity for chlorinated solvents while maintaining a relatively temperature-independent resonant frequency. Then, the article by Bryden et al. describes a collaborative effort between APL, the Johns Hopkins Medical Institutions, and the University of Maryland—Baltimore County on the development and application of a very small time-of-flight mass spectrometer. Expected applications of this instrument include the field measurement of solid, liquid, and vapor samples for microorganism identification; environmental monitors; and law enforcement purposes.

During these times of tight budgets, sponsors want systems that do the job faster, cheaper, and better. Meeting these requirements often requires sensors that have higher sensitivity, specificity, speed, and dynamic range, yet are smaller and cheaper and require less power. The final article in this issue, by Benson, Murphy, and Charles, presents a completely new approach to producing sensors based on microelectromechanical systems. These devices potentially provide an integrated capability to gather information (using a sensor function), to process information (using microelectronics), and to control the local environment (using an actuator function).

THE AUTHORS



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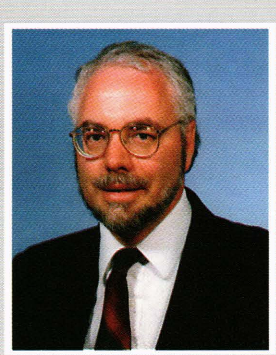

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