

THE DRAPER TECHNOLOGY DIGEST

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ADDRESS

from the President & CEO, VINCENT VITTO



The third annual publication of the Draper Technology Digest presents a selection of the Laboratory's best published or presented papers and best awarded patents from calendar year 1998. The technologies and applications described herein illustrate the Laboratory's breadth and depth in such areas as guidance, navigation, and control systems; information and decision systems; microelectromechanical and micro-optical systems; and system integration. The Laboratory provides exceptional people an environment for significant technical achievement. The Draper Technology Digest is an opportunity to salute the scientists, engineers, and technicians whose work is reported here.

Draper Laboratory's mission is to pioneer in the application of science and technology in the national interest. As an independent, not-for-profit corporation, the Laboratory is engaged in applied research, engineering development, education of a new generation of engineering students, and the transfer of technology developed at the Laboratory to the government and industry. Draper's technical staff continue to strive to ensure that the Laboratory will continue to be recognized as the nation's premier laboratory focussed on the measurement, analysis, simulation, and control of complex, dynamic systems. Our sponsors include the U.S. DoD, NASA, other government organizations, and commercial enterprises.

In June 1998, Draper celebrated the completion of its first quarter century of service to the nation as an independent institution. The technologies have changed significantly, and our funding has seen a transition over the past few years, which indicates a diversification of the Laboratory's work in a dynamic funding environment that offers opportunities as well as challenges.

As we look back at our considerable achievements, the scientists and engineers of the laboratory are looking forward to expanding the functions of existing technologies and creating new ones. Programs that have exhibited growth include: strategic guidance technology; microelectromechanical (MEMS) systems; GPS/INS for precision guided weapons; tactical mobile robots; fault-tolerant computing technology and autonomous air vehicle programs. We have renewed the Laboratory's emphasis on developing first-of-a-kind systems incorporating Draper's innovative technologies and the capabilities of the technical staff, and leveraging our core competencies into new government and commercial markets.

Draper Laboratory is proud of its heritage of engineering achievement and dedicates its resources to strive for ever greater accomplishments as we enter the next millennium.

OVERVIEW

by Vice President, Engineering, ELI GAI

Information dissemination is an important aspect of the technical activity at Draper Laboratory. It is achieved through presentation of papers at conferences, the publication of papers in reference journals, and the application for patents. To encourage this activity, two awards are presented annually by the Vice President of Engineering. One of these awards is to the staff member who published the best paper during the past year. The other award is for the best patent issued during that year. The winning paper and patent, along with other papers and patents that were nominated for these awards, are published in this digest. The selection is made by a committee chaired by the Director of Education, and includes the Engineering Directors, the Principal Director for Engineering, and the Vice President of Engineering.

Six papers and one patent are featured in this third edition of the Draper Technology Digest. The selected papers and patent reflect the diverse interests and capabilities of our technical staff. The first paper is a survey paper on inertial sensor technology trends. Since Draper Laboratory is the world leader in this area, and because inertial sensors play such an important role in precision guided weapons, this paper should be of great interest to a wide audience. The second paper describes the application of Micro Electro Mechanical Sensors (MEMS) for geophysical measurements. It demonstrates the ability of Draper engineers to leverage our investment in inertial MEMS to other sensors and different applications.

The third and fifth papers represent two aspects of Draper's capabilities to design and analyze real-time control systems. The paper authored by M. McConley and B. Appleby is a significant contribution to the theory of the stability of nonlinear controls. It extends the concept of local stability to regional stability using knowledge of plant dynamics. The fifth paper describes the application of classical control design techniques to the design of an attitude control system for a reusable launch vehicle. This paper, by D. Rubenstein and D. Carter, won the Engineering Vice President's Award for the best paper published in 1998.

The design of fault-tolerant computer systems is another area in which Draper is a world leader. The fourth paper highlights some of Draper's recent contributions to the field. The sixth paper deals with Draper's experience in setting requirements for the design of software systems. Since most software failures are attributable to requirements errors, a systematic approach to setting requirements is crucial to achieving reliable software systems.

The winners of the 1988 Engineering Vice President's Award for best patent were A. Kourepenis, P. Ward, and M. Weinberg. Their patent describes a temperature-insensitive silicon oscillator and its use as a precision voltage reference, which is a key element for high-performance inertial systems.

This year, Rami Mangoubi, a senior member of Draper's technical staff received a special award for his book, *Robust Estimation and Failure Detection: A Concise Treatment*, published by Springer-Verlag. The book brings together two areas of advanced signal processing - optimal estimation and fault tolerance. A brief summary of this publication is included herein.

These six papers, the patent, and the book reflect the continuing inventiveness and creativity of our staff. It is my pleasure to share this information with you.

