Preface

The successful completion of the Apollo-Soyuz Test Project (ASTP) in July 1975 marked the end of NASA's Saturn program and the closing of a period in which the interaction between man and technology has contributed to some of the most spectacular achievements in modern history. It would be difficult to attach a figure of merit to the contribution of digital data processing to the total space program; however, there is no doubt that its role was significant over a broad spectrum of activities.

As we enter the initial phases of a new era, the era of space flight in which the Space Shuttle (a manned vehicle combining aeronautics and astronautics) will transport men, equipment, laboratories, satellites, and propulsion stages into Earth orbit and back, the digital computer continues to play an important role both on-board and on the ground.

The nine papers in this issue illustrate the breadth of space-related technology and the variety of related problems that can be studied by means of digital computation, as well as the depths to which the subtleties of those problems can be explored. Our main concerns, in selecting these papers, have been to achieve diversity of content and to provide some insight to and understanding of the functional capabilities and implementation methods of digital data processing in aerospace applications, rather than to establish the rigorous mathematical foundations of design criteria.

The introductory paper by *C. C. Kraft, Jr.,* Director of the NASA Johnson Space Center, emphasizes the relationships between the space program and the data processing industry as well as the benefits that have resulted from that interaction.

Cooper and Chow explore the evolution of the on-board digital computer for seven space vehicles—from Saturn I through the Space Shuttle. Their paper indicates how technological developments have contributed to the rapid evolution of on-board spacecraft control, and how the stringent requirements of the space program have triggered the development of new technologies and sophisticated data processing techniques.

Sklaroff describes the complexity of the reliability problems encountered in the development of the Space Shuttle avionics system and the proposed solutions to those problems. Some of the redundancy management approaches described in this paper can be applied to solving reliability problems in other environments.

Kidd and Wolfe discuss the modeling techniques and parameters used in evaluating the remote sensor systems used in the exploration of Earth resources. The mathematical models reflect both the critical characteristics of the sensor components and the atmospheric effects that cause significant distortion of sensor data.

Bernstein provides a systematic account of computer-based methods for image processing of sensor data. He discusses the principal error sources and the techniques used for error correction. Digital processing techniques, applied to data perceived by sensors that are far more susceptible to a broad stimulus spectrum than our own senses, enable us to reveal details obscured by our physiological limitations. This paper points to a wide range of applications as we move from the problem of obtaining data to the more difficult problem of interpreting the data.

Coon and Irby describe the digital processing system for attitude control of the Skylab. The authors illustrate the versatility of the fully digitized system and the accurate maneuvering capability of the first manned space vehicle containing such a system.

Hudson reviews the digital processing techniques being applied to the stringent requirements of pointing control for the Large Space Telescope, which will take the astronomer's optics above the hazy and turbulent atmospheric envelope that encases the Earth and significantly degrades astronomical observations. Highly reliable systems are to be used so that a high resolution guidance system will be able to aim observational instruments with an accuracy of 0.01 arc-second and follow a target for extended periods of time.

Byrne, Doolittle, and Hockenberger present a functional description of the launch processing system for the Space Shuttle; they describe the relationships among the components and subsystems in this complex. This paper introduces the hardware that will control and perform much of the Space Shuttle vehicle checkout, automatically, while the vehicle components are being processed for launching.

Sohoni proposes an algorithm for determining a time sequence of powered manuevers to be invoked in case of a premature or abnormal termination of a Space Shuttle mission during its ascent phase. He discusses the guidance concept, describing the parameters to be considered, and illustrates the different stages of the processing algorithm by a numerical example.

Many other papers related to current activity in digital data processing and space technology are being published continuously. The papers in this issue give reference to much of that material.

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