The Way It Was

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This short article presents events leading to the formation of the IEEE Control Systems Society. The years prior to World War II saw two engineering societies—namely, the American Institute of Electrical Engineers (AIEE) and the Institute of Radio Engineers (IRE)—as representing almost two separate disciplines. The AIEE predominantly was governed by a membership whose ties were in heavy-equipment manufacturing and electric utilities, while IRE membership ties were geared toward the radio-broadcasting and radio-receiver manufacturing areas.

The IRE published monthly the *Proceedings of the Institute of Radio Engineers*, which was a high-level technical journal possessing articles of general interest to the radio-frequency community. The AIEE, on the other hand, published *Electrical Engineering*, which was a journal less technical than the *Proceedings* of the IRE and was directed toward the broad interests of the electrical industry. Their policy was to publish their technical papers in the annual proceedings of the Institute.

Looking at the educational pattern of the time found the electrical engineering curriculum in universities to be oriented toward heavy equipment and sprinkled with only a few electronics courses. For the most part, these curricula were hardware- and design-oriented. World War II found most of our engineering graduates too design- and handbook-oriented to undertake the development of new and novel aircraft, ultrahigh-frequency communication systems, radar systems, armament systems, etc. It turned out that this work fell on the shoulders of classical physicists, for the most part, who directed the major research and development teams during this period. This was recognized at MIT and, after the termination of hostilities, completely revised their engineering curriculum under the direction of Dr. Gordon S. Brown in order to make it more theoretically oriented despite objections from much of the engineering community. As the years passed, MIT's influence was felt throughout electrical engineering departments across the country, and resulted in a major change in the electrical engineering curricula of most schools.

Thus, during the 1945–1955 period, the United States turned out theoretically oriented students, who sought challenging employment in the then new areas of computers, control, radar, television, to mention only a few. In a short period of ten years, electrical engineers became the most sought-after individuals to work in the exploding technical revolution. These young engineers' professional interests were outside the radio and power industry, and resulted in much dissatisfaction within AIEE and IRE.

The IRE, which was young and smaller in size than AIEE, sensed this ferment. In 1950, the IRE created the following nine technical groups: Audio Group; Antenna and Wave Propagation Group; Broadcast Transmission and Systems Group; Circuit Theory Group; Instrumentation Group; Nuclear Science Group; Quality Control Group; Radio Telemetry and Remote Control Group; Vehicular Communications Group. These groups "sailed their own respective boats," so to speak. They generated specialist conferences and managed their own publications.

During the early 1950s, the IRE Group on Automatic Control was formed, and in May 1956 published the first issue of *Transactions of the Group on Automatic Control*. The early active participants of the group included the well-known George Axelby, Gordon S. Brown, George Biemson, Eugene M. Grabbe, John C. Lozier, William K. Linvill, O. Hugo Schuck, and John Ward. Almost all of these individuals have continued to be active in the control systems area in the many years since then.

Being older, the AIEE structure was dominated by heavy-equipment people reluctant to adjust to the changing times. However, in 1952, AIEE expanded its organizational structure to include three major divisions: Division I—Communication and Electronics, Division II—Applications and Industry, and Division III—Power Apparatus and Systems. Each division had a number of technical committees, which were charged with the review of technical papers and arrangement of technical sessions at the annual winter and summer meetings of the Institute. Their format was to have preprints of the technical papers on the program available at the annual summer and winter meetings of the Institute. However, not all preprints were approved for publication in the bound volumes of the Institute's annual proceedings.

Thus, by 1955, the structures of AIEE and IRE were well-established, and their publication procedures and policies were well-documented. The AIEE Feedback Control System Committee had been put under the Applications and Industry Division, which resulted in the majority of the group's members being from the heavy industries who had little interest in the latest theories in the control systems area. In order to alleviate this problem, a number of subcommittees were created. These included Linear Systems, Nonlinear Systems, Sampled-Data Systems, Control System Components, and Applications. Although the subcommittee structure provided a method for handling the ever-increasing volume of papers and the scheduling of technical sessions at the two annual meetings, the actual publication of the papers was a source of dissatisfaction. The early participants in the Feedback Control Systems Committee included the well-known Harold Chestnut, Gene Franklin, Louis F. Kazda, H. T. Marcy, N. B. Nichols, George Newton, John Raggazzini, John Truxal, and John Zaborszky.

During 1959–1963, the AIEE attracted few new members, while the membership in the IRE continued to increase, principally because of their professional group structure, which allowed the professional groups greater autonomy, and because of student activity. The discussions of an AIEE–IRE merger persisted for perhaps two years at the board of directors level. At the lower Feedback Control Systems Committee—Automatic Control Group level, we were asked to explore ways of creating a professional structure that would meet the needs of the joint control systems membership, while eliminating some of the criticism about the existing structures.

The existing paper review structure by members of the Feedback Control Systems Committee was considered unsatisfactory primarily because of a lack of coordination and the method of handling reviews. The
Automatic Control Group used an editor who had sole responsibility over the publication policy of the group. Both were considered unsatisfactory. Thus, at a committee meeting of the groups during the 1963 Joint Automatic Control Conference, Louis F. Kazda presented his ideas of creating an Information Dissemination Committee (IDC), whose sole responsibility was to handle the reviewing of the technical papers, scheduling of technical sessions, and the publication of the Transactions on Automatic Control. The Vice-Chairman of the Professional Group on Automatic Control would be chairman of IDC. The IDC would be composed of the chairmen of the various technical area committees and the editor of the Transactions. The technical areas were to be specified by the Administration Committee, which could create or eliminate technical areas as the group's needs changed. The chairmen of the technical area committees were responsible for handling the review of the papers. The editor would handle the printing and publication of the Transactions, and would be the group's contact with IEEE headquarters in regard to publication deadlines, page costs, and any problems associated with the printing of the Transactions. In order to maintain the publication schedule, as imposed by IEEE headquarters, the IDC met quarterly to review the recommendations of the technical committee chairmen and of the editor. Although IEEE headquarters viewed it initially as an unwieldy structure, it has been utilized by the Group on Automatic Control and later by the Control Systems Society for 20 years.

During 1962–1967, it was the combined efforts by such persons as Michael Athans, George Axelby, Harold Chestnut, Louis F. Kazda, N. B. Nichols, O. H. Schuck, and John Zaborszky that forged the organizational structure of the IEEE Control Systems Society.

IEEE Press Books

Adaptive Methods for Control System Design

Adaptive Methods for Control System Design, edited by Madan M. Gupta with Chi-Hau Chen as Associate Editor, is a volume in the IEEE Press Selected Reprint Series, prepared under the sponsorship of the IEEE Systems, Man, and Cybernetics Society. The emergence of new and complex technological systems over the past two decades has demanded better control systems. New technological systems have to work in environments about which very little is known. This has led to a better appreciation of adaptive methods for control system design.

The field of adaptive control has evolved progressively over the last few decades. However, until now, there has been no single resource to which students or researchers could refer to in learning about the major developments. Adaptive Methods for Control System Design is the first book that covers a wide spectrum of adaptive methods in feedback control systems that have been developed over the last two decades. The book deals with most of the major adaptive control methods, and the reprints provide historical perspectives, overviews of theoretical and applied research, and detailed treatments of some important concepts, as well as references to the wealth of papers in the field.

The book consists of 44 reprinted articles, divided into seven parts: 1—Adaptive Control: General Introduction; 2—Model Reference Adaptive Approach; 3—Self-Tuning Regulators; 4—Adaptive Control of Uncertain Plants; 5—Applications to Aircraft Control Problems; 6—Applications to Adaptive Autopilots; and 7—Application to Process Control, Robotics, and Other Fields. The book is a sourcebook for anyone within the field of adaptive control, including graduate students, researchers, and control system design engineers.

Reader Service #20

Residue Number System Arithmetic


In the first century A.D., the Chinese scholar Sun-Tzu authored a book that contained an obscure verse called t'ai-yen (great generalization) to determine a number having remainders 2, 3, and 2 when divided by 3, 5, and 7, respectively. In this verse, Sun-Tzu had described a three-modulus residue number system (RNS) with prime moduli [3, 5, 7]. The verse stated a rule that was further refined by scholars throughout many centuries and later called the Chinese remainder Theorem. Eventually, this theorem became an important cornerstone in the modern theory of RNS arithmetic.

Residue Number System Arithmetic reviews the historical development of the RNS theory and traces the modern efforts to use the theory to enhance the capabilities of modern digital systems. The editors present a set of basic definitions and establish a uniform notation that is used throughout the text. The book consists of 54 reprinted papers divided into seven parts: 1—Introduction and Background; 2—Data Conversion Methodology; 3—RNS Computational Hardware; 4—RNS Digital Filters; 5—RNS Applications to DFTs and Convolution; 6—Error Detection and Correction in Residue Number Systems; and 7—Soviet Developments in the Application of Residue Number Systems to Computer Technology.

Reader Service #21

Adaptive Methods for Control System Design

(Order number PC01651) contains 488 pages and is priced at $60.00 ($45.00 for IEEE members). Residue Number System Arithmetic: Modern Applications in Digital Signal Processing (Order number PC01982) contains 430 pages and is priced at $50.95 ($30.20 for IEEE members). The books may be ordered postpaid from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854-4150. Make check payable to IEEE. A $2.00 billing charge is added to all nonprepaid orders of under $100.00. Credit card orders (MasterCard, VISA, American Express, and Diners Club) are acceptable and considered prepaid.