

Professor Yasundo Takahashi— Profile of a Controls Pioneer

Born in Nagoya-Shi, Japan in 1912, Professor Takahashi attended the University of Tokyo where he received his Bachelor's degree in 1935. By 1951 he earned his doctorate.

After receiving his Bachelor's degree he went to work for the Japanese Government Railways as an assistant design engineer until 1937 when he joined the faculty at the Yokohama Technical College as an assistant professor. In 1940 he went on to Nagoya University as an assistant professor there and then to Tokyo University in 1944. By 1946 he attained full professorship at the University.

In 1954 he came to the Massachusetts Institute of Technology as Visiting Fellow under a Fulbright Grant. In 1955 he joined the faculty at the University of California, Berkeley.

A Fellow of ASME, Professor Takahashi is also a member of the Instrument Society of America, the American Association for the Advancement of Science, the Japan Society of Mechanical Engineers, the Japan Society of Measurement and Control and the Japan Association of Control Engineering. He also belongs to Pi Tau Sigma.

Among the honors he has received was that of honorary membership in both the Mexican Society of Automatic Control and the Japan Society of Measurement and Control. In 1972 and 1973 he was given a grant from the Organization of American States. In 1977 he received an honorary doctoral degree from the University of Grenoble, France.

Professor Takahashi has worked on many problems in automatic control ranging from process analyses and control system designs to the theory for new digital control algorithms. He is most widely known for his seminal work on the dynamic modeling, simulation and design of heat exchangers. He provided the superb definitive theory for the dynamics and control of heat exchange processes during the 1940's. This work received its well-deserved international recognition upon presentation and subsequent publication of his paper "Transfer Function Analysis of Heat Exchange Processes" at the Department of Scientific and Industrial Research (DSIR) Conference on Automatic Control at Cranfield, England, in 1951.

During Professor Takahashi's first visit to the United States as a Fulbright Scholar, he made vital heat transfer contributions to the work of the U.S. Corps of Engineers, in connection with the "Dew Line," through the Snow, Ice and Permafrost Research Establishment (SIPRE) and the Arctic Construction and Frost Effects Laboratory (ACAFEL), both of which were subsequently combined into the Cold Regions Research and Experimental Laboratory (CRREL) at Hanover, New Hampshire, where Takahashi's pioneering work is still in evidence. Other major contributions to process control at this time were made through the Foxboro Company, the Woodward Governor Company, and other organizations.

In some of the above work and other related activities, Professor Takahashi co-ventured research and engineering studies with Dr. H. M. Paynter. Their joint publications, arising from a unique partnership, are today recognized and valued the world over.

His current research work is focused on the development of a family of control algorithms suitable for microprocessor or calculator based controllers. The central theme of this work is to take advantage of developments in discrete-time control theory, such as adaptive control, while recognizing the limitations imposed by the memory and computing speed characteristics of microcomputers.

He has inspired hundreds of students over the last 20 years while teaching at Berkeley, and (as an invited visiting professor) at the University of Grenoble, France, the University of Tokyo, the Institute Politecnico of Mexico and the University of



LaPlata, Argentina. At the University of California, Berkeley, for example, he has directly supervised 14 students in their doctoral research. These students came from all parts of the world and are now working in universities, private industry, and government.

On the occasion of the 70th anniversary of the Japan Society of Mechanical Engineers in 1967 he received an award for outstanding services and contributions to the profession. He is the author or co-author of six different books, 4 in Japanese and 2 in English.

Another indication of his important contributions to the field of automatic control is the extremely active role he has played in the Automatic Control Division of the Society (which was known as the Instrument and Regulator Division from 1943 to 1961). He was active in the Division before and after its name change in many roles, including: chairing numerous paper sessions, giving many papers and presentations at ASME meetings, serving on the Executive Committee of the Division, and serving as Editor of the Division's journal. It is worthy of note that when he took on the role as Chairman of the Executive Committee of the Automatic Control Division, he was instrumental in reviving interest in the Division and breathing new life into its activities.

In his quiet, professional and unassuming way Dr. Takahashi has been instrumental in strengthening the intellectual and spiritual leadership in the United States over the past twenty years for those mechanical engineers working in the automatic control field.

Major Publications of Yasundo Takahashi

(a) Books

- 1 *Theories of Automatic Controls* (in Japanese), Iwanami, Tokyo, Japan, 1954.
- 2 *Control System Design Notes* (in Japanese), Kyoritsu-sha, Tokyo, Japan, 1954.
- 3 *Systems and Control*, (in Japanese), Iwanami-shoten, Tokyo, Sept. 1968.

4 *Control* with M. Rabins and D. M. Auslander, Addison-Wesley, Jan. 1970.

5 *Dynamic Systems via Computer Simulation* (in Japanese), Kagakugijutsu-sha, Japan, Nov. 1970.

6 *Introductory Systems & Control* with M. Rabins and D. M. Auslander, McGraw-Hill, 1974.

(b) Papers

1 With H. M. Paynter, "A New Method of Evaluating Dynamic Response of Counter and Parallel Flow Heat Exchangers," *TRANS. ASME*, Vol. 78, No. 4, May 1956, p. 749.

2 With F. Boyadjieff, D. Eggleston, M. Jacques, and H. Satabutra, "Some Applications of the Maximum Principle to Second-Order Systems, Subject to Input Saturation, Minimizing Error, and Effort," *ASME Journal of Basic Engineering*, Vol. 86, No. 1, Mar. 1964, pp. 11-22.

3 With E. Sarti, "An Extension of the Describing Function Method," *ASME Journal of Basic Engineering*, Vol. 88, No. 2, June 1966, pp. 469-474.

4 With E. G. Yore, "Identification of Dynamic Systems by Digital Computer Modeling in State Space," *ASME Journal of Basic Engineering*, Vol. 89, 1967, pp. 295-299.

5 With W. V. Loscutoff, P. R. Ragetly, E. Goldberg, and H. Thal-Larsen, "Mode Oriented Design Viewpoint for Linear Lumped Parameter Multi-Variable Control Systems," *ASME Journal of Basic Engineering*, Vol. 90, 1968, pp. 222-230.

6 With H. F. Millars, "Optimal State Variable Feedback with Bounded Gains," *ASME Journal of Basic Engineering*, Vol. 91, 1969, pp. 251-256.

7 With M. Tomizuka and D. M. Auslander, "Simple Discrete Control of Industrial Processes (Finite Time Settling Control Algorithm for Single-Loop Digital Controller)," *ASME JOURNAL*

OF DYNAMIC SYSTEMS, MEASUREMENT, AND CONTROL, Vol. 97, No. 4, Dec. 1975, pp. 354-361.

Other Papers

8 "Transfer Function Analysis of Heat Exchange Processes," on *Automatic and Manual Control*, by A. Tustin, Butterworths Publ., London, 1952.

9 "Regeltechnische Eigenschaften der Gleich- und Gegenstrom Wärmeaustauschern," *Regelungstechnik*, Heft, 2, Jg. 1, p. 32, 1953.

10 "You Need No Computer to Graphically Determine the Dynamics of Heat-Percolation," *Control Eng.*, May 1955.

11 "A New Form of Transfer Functions of Monotone Systems," *Automatic Control (Japan)*, Vol. 3, No. 4, 1956, pp. 207-214.

12 "Response of Heat Exchangers for Flow Rate Inputs," *Automatic Control (Japan)*, Vol. 6, No. 1, Feb. 1959, pp. 2-7.

13 "Ten Years in Automatic Control Field," *J. Instr. Soc. Amer.*, Vol. 4, No. 3, Oct. 1957, p. 151.

14 "Process Control with a Velocity Limit," (with J. G. Ziegler and N. B. Nichols), *Automatic & Remote Control*, Proc. IFAC, 1961, pp. 175-180.

15 "Time Optimal Control of a Chemical Reactor," (with J. E. Cotter), *Process Systems Eng.*, Chem. Eng. Process, Symp. Ser., Vol. 59, No. 46, 1963, pp. 119-126.

16 "Introduction to Modern Control Theory," (a series of 12 articles), *Control Eng. (Japan)*, from March 1968 to February 1969, Vol. 12, pp. 169-173, 240-247, 294-300, 358-365, 439-446, 501-508, 572-579, 649-656, 701-708, 775-781; Vol. 13, pp. 73-79, 137-143.

17 "Parameter-Einstellung bei linearen DDC-Algorithmen," (with D. M. Auslander and C. S. Chan), *Regelungstechnik*, Jg. 19, Heft 6, 1971, pp. 237-284.