FEATURE

Women in the Field of Control Systems

By N. Harris McClamroch and Bozenna Pasik-Duncan

The history of the development of control systems in the 20th century is well documented. Although relatively few women specialized in the control field during much of the 20th century, women did make important contributions to the foundations of the field through their accomplishments in developing basic control theory, control applications, and control systems technology. Only in the 1950s and 1960s did a few women begin to establish research careers in control systems. Many of these women came to control systems with backgrounds in mathematics, so they naturally worked on the more mathematical aspects of control systems theory.

This article focuses on six women who made important contributions to the control systems field. For each, biographical data is provided, as well as a sketch of their research interests and accomplishments. All of these women had to make their way in a field dominated by men. Their

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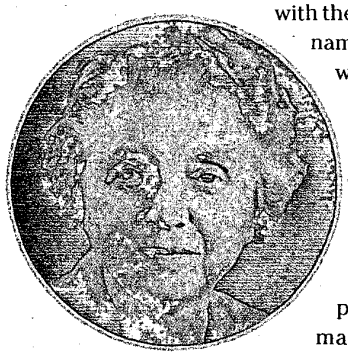
successful careers are a credit to their perseverance and to their commitment to the field. These women helped to make the control field the exciting and important discipline it is today. They serve as models for all of us.

Irmgard Flugge-Lotz

Irmgard Flugge-Lotz is known for her contributions to aerodynamics, automatic control, and aircraft flight systems. She was born 16 July 1903, in Hameln, Germany, and died 22 May 1974. A memorial article appeared in the *IEEE Transactions on Automatic Control,* vol. AC-20, no. 2, April 1975, pp. 183a-183b.

Lotz graduated from high school in 1923 and enrolled in the male-dominated Technical University in Hannover where she studied applied mathematics. She was the only woman in many of her classes. In 1927, she earned the degree of Diploma-Ingenieur, and in 1929, she became a Doktor-Ingenieur, with a thesis on the mathematical theory of heat conduction in circular cylinders.

Lotz joined the Aerodynamische Versuchsanstalt (AVA), a research institute in Göttingen, where she worked closely with the leading German aerodynamicists of the time, Ludwig Prandtl and Albert Betz. Before Lotz's arrival, Prandtl had been studying the integro-differential equation for his lifting line theory for the span-wise lift distribution of an airplane wing. Applying her mathematical skills, Lotz was able to solve the equation and to develop a relatively convenient method for practical use.



In 1938, Lotz married Dr. Wilhelm Flugge. A civil engineer, Flugge had just accepted a position as a department head at the Deutche Versuchsanstalt fur Luftfahrt (DVL) in Berlin. The leaders of the DVL quickly became aware of the talent possessed by Flugge's wife and offered her a position as consultant in aerodynamics and flight dynamics. At DVL, she began her career in automatic control theory, developing the theory of discontinuous or on-off control systems.

In 1947, the Flugges accepted offers to join the newly established ONERA (French National Office for Aeronautical Research) in Paris. Flugge-Lotz served as chief of a research group in aerodynamics until 1948, and she published papers in both automatic control theory and aerodynamics.

The Flugges left Paris for the United States in 1948 to accept positions at Stanford University. Since her husband was hired as a professor, Flugge-Lotz could only be hired as a lecturer in engineering mechanics and a research supervisor, due to Stanford's nepotism policy of not hiring married couples to professorship positions.

Flugge-Lotz continued her work in fluid mechanics, numerical methods, and automatic control. At Stanford, she developed new courses, guided the research of many Ph.D. students, and co-authored research reports with her students. The number of her students had grown so much that, by 1951, she established a weekly fluid mechanics seminar at which faculty and students met to discuss ideas. It became evident that Flugge-Lotz was carrying on the duties of a professor without official recognition.

These women helped to make the control field the exciting and important discipline it is today. They serve as models for all of us.

In 1960, Flugge-Lotz was the only female delegate from the United States at the first Congress of the International Federation of Automatic Control, held in Moscow. In the fall of 1960, she was finally appointed full professor in both engineering mechanics and aeronautics and astronautics. She was Stanford's first female professor in engineering.

In 1970, Flugge-Lotz received the Achievement Award from the Society of Women Engineers. She was the first woman elected as a Fellow of the American Institute of Aeronautics and Astronautics in 1970, and in 1971, she was the first woman to be selected to give its prestigious von Karman Lecture. She received an honorary Doctor of Science degree from the University of Maryland in 1973.

Flugge-Lotz retired in 1968, but she continued research on satellite control, heat transfer, and drag on high-speed vehicles. Throughout her career, she published more than 50 technical papers and several books. A few examples of her publications include:

- I. Flugge-Lotz, *Discontinuous Automatic Control.* Princeton, NJ: Princeton Univ. Press, 1953.
- I. Flugge-Lotz, "Synthesis of third-order contactor control systems," in *Proc. First Int. Congr. International Federation of Automatic Control*, Moscow, 1960.
- I. Flugge-Lotz, *Discontinuous and Optimal Control.* New York: McGraw-Hill, 1968.
- J.L. Garcia Almuzara and I. Flugge-Lotz, "Minimum time control of a nonlinear system," *J. Differ. Equ.*, vol. 4, pp. 12-39, 1968.
- D.W. Ross and I. Flugge-Lotz, "An optimal control problem for systems with differential-difference equation dynamics," *SIAM J. Contr.*, vol. 7, pp. 609-623, 1969.

- I. Flugge-Lotz, "The importance of optimal control for the practical engineer," *Automatica*, vol. 6, pp. 749-753, Nov. 1970.
- W.H. Boykin and I. Flugge-Lotz, "High-accuracy attitude control of satellites in elliptic orbits," *J. Optim. Theory Appli.*, vol. 5, pp. 197-224, Mar. 1970.
- I. Flugge-Lotz, "A neighboring optimal feedback control scheme for systems using discontinuous control," *J. Optim. Theory Appli.*, vol. 8, no. 5, 1971.
- I. Flugge-Lotz, "Trends in the field of automatic control in the last two decades," *AIAA J.*, vol. 10, pp. 721-726, 1972.

Violet Haas

Violet Haas contributed to control engineering research and education. She was born in New York City on 23 November 1928 and died on 21 January 1986.

Haas graduated from Brooklyn College with an A.B. degree in 1947. She received a Ph.D. degree in mathematics in 1951 from Massachusetts Institute of Technology. The title of her doctoral thesis was "Singular Perturbations of an Ordinary Differential Equation." Although she achieved much academic success as a student, she later recalled being a student during World War II, when many men were serving in the armed forces, but she was only grudgingly provided office space and other graduate student resources because of her gender.

Haas began her career as a Lecturer and Instructor in mathematics at Immaculata College in Pennsylvania and subsequently joined the University of Connecticut and Wayne State University. After a five-year academic appointment at the University of Detroit, she joined the School of Electrical Engineering at Purdue University in 1962. At this time, Purdue University had a large and influential group of control engineers in the Control and Information Systems Laboratory, including such individuals as K.S. Fu, S. Shridar, Z.V. Rekasius, and J.B. Pearson; the group was under the leadership of J. Gibson. Although many of these individuals left Purdue University shortly afterward, Violet Haas remained and continued to provide important continuity for the control program.

Throughout her career, control systems theory remained Haas's major interest. Her research dealt with many problems in optimal control, including singular optimal control, optimal control of hereditary systems, conjugate points, and singular LQG problems. In addition, she worked on stability, estimation, and numerical methods in control. She published more than 30 journal and conference papers, as well as a handbook on analog computing. Several example publications are the following:

- V.B. Haas, "On normality and conjugate point criteria for singular extremals," *SIAM J. Contr.*, vol. 13, pp. 1172-1182, 1975.
- V.B. Haas, "The Clebsch and Jacobi conditions for singular extremals," *Int. J. Contr.*, vol. 27, pp. 557-570, 1978.
- V.B. Haas, "Positivity of a quadratic functional," *IEEE Trans. Automat. Contr.*, vol. AC-24, no. 6, pp. 970-974, 1979.
- V.B. Haas, "The singular, steady state, linear regulator," *SIAM J. Contr. Optim.*, vol. 20, pp. 247-257, 1982.
- V.B. Haas, *Analog Computer Handbook*. Bloomington, IN: Publications Press, 1982.

Haas supervised the doctoral theses of eight students at Purdue. She had a positive influence on many students and colleagues, encouraging and helping them to develop their own interests in control theory.

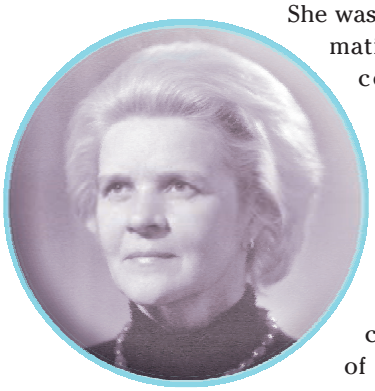
Haas received several awards and honors. She was an American Association of University Women Vassie James Hill Fellow in 1951 and a National Science Foundation Science Faculty Fellow in 1960. A student scholarship is named in her honor at Purdue University.

Haas maintained many interests outside of her academic life. She had three children; her husband was for a time Chair of the Mathematics Department and later Provost at Purdue University. She was active in many university and community organizations. Professionally, she was active in the American Society for Engineering Education, the IEEE, the Society of Industrial and Applied Mathematics, and the Society of Women Engineers.

Faina M. Kirillova

Faina Kirillova was born on 29 September 1931 in Zuevka, Kirov region, Russia, USSR. Her research areas include qualitative theory of optimal control, general theory of extremal problems, optimization algorithms, synthesis of optimal control systems, and control stabilization.

Kirillova received an M.S. degree from the Ural State University, Ekaterinburg (Sverdlovsk), Russia, in 1954 and a Ph.D. degree (under the supervision of Academician N.N. Krasoskii) from Moscow State University, Moscow, in 1961.



She was the first woman mathematician in Belarus to receive the Doctor of Science degree from State University of St. Petersburg in 1968. Her professional experience included serving as Head of the Department of Control Processes Theory, Institute of Mathematics. She was

the first woman mathematician to become a corresponding member of the National Academy of Sciences of Belarus, Minsk, Belarus, in 1969. She was Professor, Department of Applied Mathematics and Informatics, Belarusian State University, from 1968 to 1976 and 1986 to1992. She supervised 46 theses dealing with the qualitative and constructive theory of optimal control, feedback control, stabilization, and control applications

Kirillova has published widely, including nine monographs and more than 300 papers in the fields of optimal control, constructive methods of optimization, fast optimization algorithms, feedback control, stabilization, and economical cybernetics. A few examples of papers and books, some written with her husband, R. Gabasov, include the following:

- F.M. Kirillova, "Contributions to the problem on the analytical construction of regulators," *J. Appl. Math. Mech.*, vol. 25, pp. 644-653, 1961.
- R. Gabasov and F.M. Kirillova, "On method of synthesis of linear optimal systems," in *Proc. Third IFAC Congress*, London, 1966.
- R. Gabasov, F.M. Kirillova, and B.S. Mordukhovich, "A discrete maximum principle," *Soviet Mathematics Dokadyl*, vol. 14, pp. 1624-1627, 1973.
- R. Gabasov and F.M. Kirillova, *The Qualitative Theory of Optimal Processes*. Moscow: Marcel Dekker, English translation, 1976.
- R. Gabasov and F.M. Kirillova, *Methods of Optimization*. Minsk, University Press, 1980. English translation, *Software Optimization*, 1988.
- R. Gabasov, F.M. Kirillova, and O.I. Kostyukova, "An algorithm for optimizing nonlinear dynamical systems," *Soviet Mathematics Doklady*, vol. 313, pp. 537-540, 1990, and vol. 42, pp. 28-31, 1991.
- R. Gabasov, F.M. Kirillova, and S.V. Prischepova, *Optimal Feedback Control* (Lecture Notes in Control and Information Sciences, M. Thoma, Ed.). New York: Springer-Verlag, vol. 207, 1995.

Kirillova has received numerous awards recognizing her control contributions. These include the Prize of the Council of Ministers of the USSR in1981, the Prize of the Council of Ministers of the USSR in 1986, and the Prize of the National Academy of Sciences of Belarus in 1995. Kirillova was elected a corresponding member of the National Academy of Sciences of Belarus in 1996 for her work in mathematical cybernetics. She has been actively involved in many professional activities, especially in the International Federation of Automatic Control (IFAC). She was a member of the IFAC Working Group on Control Applications of Nonlinear Programming, 1975-1989; Vice-Chairman of the IFAC Committee on Mathematics in Control, 1981-1990; Chairman of the IFAC Working Group on Control Applications of Optimization, 1990-present; and Chairman of the IFAC Technical Committee on Optimization Methods, 1994-1996. She is President of the Belarusian Association of Control and Management, 1994-present, and is a member of the editorial boards of the journals *Optimization* (Germany) and *Control and Cybernetics* (Poland).

Kirillova's technical contributions have been numerous, especially to optimal control theory and optimization methods. She was an early proponent of the use of a functional analysis approach to the solution of linear optimal problems. She developed important conditions for controllability and observability of linear control systems with delay. She provided a justification for the universal form of necessary optimality conditions for complex control systems based on variational derivatives. She discovered and justified (together with R. Gabasov) the quasi-maximum principle for discrete-time control systems and pioneered its application. She also developed a new numerical approach to solving linear programming problems, and she created numerical methods for the solution of linear, quadratic, nonlinear programming, and optimal control problems. In the 1990s, her research concentrated on construction of optimal feedback controllers and their application.

Kirillova has three daughters. One of her daughters, Olga Gabasova, works on control applications in economics after having completed her Ph.D. thesis in 2000. Kirillova's husband, Rafail Gabasov, is a Professor, and for 31 years he was head of the Department of Optimal Control in Byelorussian State University.

Makiko Nisio

Makiko Nisio was born in 1931 in Japan. She received her first degree in chemistry in 1953 from Kyoto University and her Ph.D. degree in 1961, also from Kyoto University under the direction of Kiyosi Ito.

From 1954 to1993, Nisio worked in the Department of Mathematics at Kobe University, where she taught probability theory and related topics, including stochastic control. She was made a Professor in 1972, and in 1993 she was appointed Professor Emeritus. Since 1993, she has been Professor of Osaka Electro-Communication University. She held visiting positions at Brown University from1963 to1965 and at the Indian Statistical Institute in 1978.

Nisio's research has been concerned with the mathematical aspects of stochastic control. She obtained a number of existence results for certain classes of stochastic optimal control problems. In this context, she is responsible for introducing the weak convergence of probability measure methods in stochastic control theory. She studied existence questions for stochastic optimal control problems defined

in terms of functional stochastic differential equations, partially observed diffusions, and stochastic partial differential equations.

Nisio also developed important results on nonlinear semigroups associated with the Bellman principle of optimality. She was able to show that Bellman's dynamic programming principle can be regarded as a semigroup property and that the Hamilton-Jacobi-Bellman equation can be viewed as the equation that describes the infinitesimal generator of the nonlinear semigroup. This approach has been widely used in stochastic control and has come to be called the "Nisio semigroup." Nisio obtained specific constructive results for optimal stopping problems and for problems with partial observations. In recent years, she has worked on control of stochastic partial differential equations and differential games in finite and infinite dimensions.

Nisio is currently an Associate Editor of the journal *Applied Mathematics and Optimization*. She is the author of numerous publications, a few of which are as follows:

- W.H. Fleming and M. Nisio, "On the existence of optimal stochastic controls," *J. Math. Mechan.*, vol. 15, pp. 777-794, 1966.
- M. Nisio, "On stochastic optimal controls and envelope of Markovian semigroups," in *Proc. Int. Symp. Stochastic Differential Equations*, Kyoto, pp. 297-325, 1976.
- M. Nisio, "On nonlinear semigroups associated with optimal stopping for Markov processes," *Appl. Math. Optim.*, vol. 4, pp. 143-169, 1978.
- M. Nisio, *Lectures on Stochastic Control Theory* (ISI Lecture Notes 9). Bombay, India: Macmillan, 1981.
- W.H. Fleming and M. Nisio, "On stochastic relaxed control for partially observed diffusions," *Nagoya Math. J.*, vol. 93, pp. 71-108, 1984.
- W.H. Fleming and M. Nisio, "Differential games for stochastic partial differential equations," *Nagoya Math. J.*, vol. 131, pp. 75-107, 1993.

Huashu Qin

Huashu Qin has been an important contributor to control research and education in China. She graduated from the Department of Mathematics, Nankai University, Tianjin, China, in 1956, and received her Ph.D. degree in mathematics from Jagiellonian University in Cracow, Poland, in 1961.

Qin was a staff member at the Institute of Mathematics, Chinese Academy of Sciences, from 1961 to 1979. In the 1960s and 1970s, she worked in the field of control theory and applications, including guidance and control of missiles and satellites and temperature control of industrial processes. Since 1979, she has been affiliated with the Institute of Systems Science, Chinese Academy of Sciences; she is currently a retired professor.

Qin's research interests cover many topics in systems and control, including bifurcations in nonlinear control systems, stabilization and tracking control of rigid robot arms, chaos control, stabilization via output feedback for nonlinear systems, and applications to power systems. She published more than 70 research articles, four books, and a research monograph. Example publications include:

- H. Qin, "On the evaluation of the solutions of a system of ordinary differential equations with an analytical right-hand member," *Ann. Poland Mathematici*, pp. 225-235, 1961.
- H. Qin, "Effects of the uncertain factors on the guidance laws," *J. Chinese Astronautics*, no. 1, pp. 17-27, 1981.
- H. Qin, "On the approximate expression of the nonzero solution in a bifurcation system," *Acta Automatica Sinica*, vol. 8, no. 2, pp. 93-102,1982.
- H. Qin, "A qualitative analysis of spatial proportional guidance," *J. Syst. Sci. Math. Sci.*, vol. 10, no. 3, pp. 207-215, 1990.
- H. Qin, "On the asymptotic assignment of the bounds of decreasing rate for a time-varying linear control system," *Mathematical Acta Scientia*, vol. 12, no. 4, pp. 463-471, 1992.

For her contributions to control theory and applications in aeronautics technology, Qin received several awards and prizes from the Chinese Academy of Sciences and from the Nation's Defense Commission of Science and Technology. She has been a member of the Standing Council, Chinese Association of Automation (CAA), since 1980 and the Chairman of the Control Theory Committee of CAA since 1993. Over the past 20 years, she has been the main organizer of the annual Chinese control conference. She was also one of the main organizers for several international conferences held in China, including the 1988 IFAC Symposium on System Identification and the 14th IFAC World Congress. She has been the Deputy Editor-in-Chief of the journal *Control Theory and Applications* since 1984. She is also on the editorial boards of several other academic journals.

Jane Cullum

Jane Cullum is a Technical Staff Member in the Computer and Computational Sciences Division at the Los Alamos National Laboratory. She is best known for her research on numerical algorithms for large-scale computations. She has also made many contributions to the systems and control field, both through her technical accomplishments and through her leadership in the IEEE Control Systems Society.

The focus of Cullum's research has been on the design, analysis, and implementation of a variety of novel numerical algorithms, many of which cross disciplinary boundaries in the sense that they are not application specific. Much of this

work has direct connections with iterative computations that arise in systems and control analysis.

Cullum was exposed to process control as an undergraduate in chemical engineering at Virginia Polytechnic Institute. She received the Lilian Moller Gilbreth Award from the Society of Women Engineers and a Woman's Badge from Tau Beta Pi. She completed her graduate studies in applied mathematics at the University of California, Berkeley, with a Ph.D. thesis topic on optimal control theory. Upon completion of her Ph.D. in 1967, she went to work at the IBM Research Center in Yorktown Heights, New York. She joined Los Alamos National Laboratory in 1998.

Initially, Cullum focused on approximations of continuous optimal control problems by either simpler continuous control problems or by finite-dimensional mathematical programming problems. Her work on mathematical programming addressed the question: How does one construct discrete (finite-dimensional) approximations to general nonlinear continuous (infinite-dimensional) optimal control problems? In a series of papers, she derived a sequence of theorems stating how to construct legitimate discretizations, and she provided justification for their use. Cullum's work in optimization was motivated by circuit simulations. This research with R.K. Brayton was one of the first to address optimization computations where there are errors in the function and gradient evaluations. This work was applied to circuit simulation applications, where errors arise from solving large systems of differential equations.

At IBM, Cullum also worked on algorithms for large-scale eigenvalue computations, stimulated by the need for better circuit partitioning algorithms. In the control area, variants of her work have been used in the analysis of various control system design algorithms that use singular values as measures of system robustness. The paper by Cullum, Donath, and Wolfe is considered a seminal paper in semidefinite programming, a generalization of linear programming that has received much attention in the last few years. Cullum's two-volume book with Ralph Willoughby contains a family of algorithms for large-scale eigenelement computations.

Cullum's recent research has been concerned with circuit simulations and model reduction problems, namely, determining a reduced-order system whose behavior mimics the relevant behavior of some larger system. The motivating application is VLSI interconnects (wires and planes) within computer packages where the large model is nonsymmetric, dense, and includes numerous time delays. Her current work at Los Alamos National Laboratory focuses on parallel algorithms for solving huge linear systems of equations. To achieve the desired scalability, the emphasis is on multilevel algorithms, algorithms that construct coarse versions of the original problem. Such algorithms can be combined with Krylov iterative methods.

Cullum has a distinguished research record and a lengthy list of publications. Example publications include the following:

- J. Cullum, "Penalty functions and nonconvex continuous optimal control problems," *Computing Methods in Optimization 2*, 2nd ed. L. Zadeh, L. Neustadt, and A.V. Balakrishnan, Eds. New York: Academic, pp. 55-66.
- J. Cullum, "Finite-dimensional approximations of state-constrained optimal control problems,"*SIAM J. Contr.*, vol. 10, no. 4, pp. 649-670, 1972.
- J. Cullum and W.E. Donath, "A block Lanczos algorithm for computing the q algebraically-largest eigenvalues and a corresponding eigenspace of large, sparse real symmetric matrices," in *Proc. IEEE Conf. Decision and Control*, 1974, pp. 505-509.
- J. Cullum, W.E. Donath, and P. Wolfe, "The minimization of certain nondifferentiable sums of eigenvalues of symmetric matrices," *Stud. Math. Program.*, vol. 3, pp. 35-55, 1975.
- J. Cullum and R.A. Willoughby, "Fast modal analysis of large sparse but unstructured symmetric matrices," in *Proc. 17th IEEE Conf. Decision and Control*, 1979, pp. 45-53.
- J.H. Chow, J. Cullum, and R.A. Willoughby, "A sparsity-based technique for identifying slow-coherent areas in large power systems," *IEEE Trans. Power App. Syst.*, vol. 103, pp. 463-473, 1983.
- J. Cullum and R.A. Willoughby, *Lanczos Algorithms for Large Symmetric Eigenvalue Computations*, *Vol. 1—Theory, Vol. 2—Programs*. Boston, MA: Birkhauser, 1985.
- J. Cullum, W. Kerner, and R.A. Willoughby, "A generalized nonsymmetric Lanczos procedure," *Comput. Phys. Commun.*, vol. 53, pp. 19-48, 1989.
- J. Cullum, A.E. Ruehli, and T. Zhang, "A method for reduced-order modeling and simulation of large interconnect circuits and its application to PEEC models with retardation," *IEEE Trans. Circ. Syst.*, vol. 47, pp. 261-273, 2000.
- J. Cullum and A. Ruehli, "Pseudospectra analysis, nonlinear eigenvalue problems, and studying linear systems with delays," *BIT*, pp. 265-281, 2001.

In addition to research at IBM Research, Cullum's professional experience includes 13 years in management. From 1979 to 1982, she managed a Numerical Algorithms Group doing research on differential equations, lithographic and macromagnetics simulation, signal processing, and modal analyses. From 1982 to 1992, she was Senior Manager of the Applied Mathematics Area in IBM Research.

Cullum has been active in the IEEE Control Systems Society, culminating in her term as President of the Society in

1989. Under her leadership, that year the Society selected the first Bode Lecturer. During her years as an officer of the Society, she supported the international aspects of the Society, educational aspects such as a videotape program, and control applications initiatives, especially through *IEEE Control Systems Magazine* and control applications conferences. In 1989, she received the Distinguished Member Award of the IEEE Control Systems Society. She was elected a Fellow of the IEEE in 1990 for her contributions to large-scale problems. In 2000, she received the IEEE Third Millennium Medal for her outstanding contributions and achievements.

In addition to her extensive involvement in the IEEE Control Systems Society, Cullum was active in the Society for Industrial and Applied Mathematics (SIAM). She started out as Secretary of SIAM, became a member of the SIAM Council, served as Vice-President at Large from 1980 to 1983, and then was a member of the SIAM Board of Trustees from 1984 until 1989.

Acknowledgments

Some of the information that forms the basis for this article was obtained from individual Web sites, as well as from traditional sources such as *American Men and Women of Science, Who's Who in Frontiers of Science and Technology*, and *Who's Who in Technology*. That information has been supplemented through suggestions and materials provided by Natalia Balashevich, Dennis Bernstein, Ray DeCarlo, Wendell Fleming, Lei Guo, Steve Morse, Hideo Nagai, Lucy Pao, and Claire Tomlin. We also express our thanks to Faina Kirillova, Makiko Nisio, Huashu Qin, and Jane Cullum for information they provided that was invaluable in developing this article. We have collected additional information about other women researchers in the control field and plan to continue collecting such information as a basis for future articles. In this regard, we welcome submission of relevant materials, information, and suggestions.

N. Harris McClamroch is a Professor at the University of Michigan. He has published papers in the areas of robustness, optimal control, estimation, stochastic control, and nonlinear control. He has worked on control engineering problems arising in flexible space structures, robotics, automated manufacturing, and aerospace flight systems. He is a Fellow of the IEEE and received the IEEE Control Systems Society Distinguished Member Award and the IEEE Third Millennium Medal. He served as Editor of the *IEEE Transactions on Automatic Control* and as President of the IEEE Control Systems Society.

Bozenna Pasik-Duncan received her master's degree from Warsaw University in 1970 and her Ph.D. and Habilitation degrees from the Warsaw School of Economics in 1978 and 1986, respectively, all in mathematics. She is a Professor of Mathematics at the University of Kansas. Her research interests are in stochastic adaptive control and mathematics and science education. She has held visiting appointments in Poland, Hungary, Czech Republic, France, Italy, Japan, and China. She was an Associate Editor of the *IEEE Transactions on Automatic Control* and is currently an Associate Editor-at-Large. She served as IEEE Control Systems Society Vice President for Membership and has chaired the Assistance of Engineers at Risk, Women in Control, and International Affairs committees. She is an IEEE Fellow and a Distinguished Member of the IEEE Control Systems Society.