

<b>Edgar H. Bristol II</b> <i>Control Concepts Originated</i> 28 Union St. Foxboro MA 02035 USA 508 543 8829 Wknd: 508 548 0782 Cell: 617 899 2702	Fellow Emeritus The Foxboro Co. e.bristol@verizon.net <a href="http://homepage.mac.com/ebristol">http://homepage.mac.com/ebristol</a> <a href="http://ebristolcrga.com">ebristolcrga.com</a>
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| - BA Math,                                       | Beloit College,   | 1957 (with Cronwell Math Award).  |
| - BSc EE,  | MIT,  | 1958 (Class of '57).  |
| - Engineer,                                      | Daystrom Electric                                       | Sept. '58 - May '59.  |
| - Research Engineer                              | The Foxboro Co.   | Nov. '59 -  |
| - Consulting Research Engineer                   | "   | -   |
| - Bristol Fellow                                 | "   | Jan. 2000   |
| - Teaching Sabbatical                            | LSU, Dept. Chem. Eng.                                   | Aug. '76 - May '77.   |
| - Honorary Lecturer                              | MIT, Dept. Mech. Eng.                                   | 1979 - 1988.  |
| - Member   | ISA, IEEE, MAA, ACM, AIChE (formerly).                  |   |
| - Boston Area Chairman                           | Boston Chapter IEEE CS                                  | 1993 - 2000.  |
| - Boston Area Secretary                          | Greater Boston Chapter ACM                              | 1995 - Present.   |
| - Regular Speaker and Session Chairman           | for ISA, IEEE CDC, AIChE, ACC.                          |   |
| - Past Officer                                   | AACC, Vice President for Planning for IEEE SMC Society. |   |
| - Active Member                                  | ISA SP50, SP88 Standards Groups.                        |   |
| - Bristol Fellow                                 | The Foxboro Co.   | Apr. '86.   |
| - Douglas H. Annin Award                         | ISA   | 1987.   |
| - Computing Practice Award                       | AIChE, CAST Division                                    | 1989.   |
| - Control Systems Technology Award               | IEEE Control Systems Society                            | 1989 (Inaugural Recipient).   |
| - ISA Fellow                                     | Instrument Society of America                           | 1996.   |
| - ACC Control Technology Award                   | American Control Conference                             | 2003.   |
| - One of 50 most influential industry innovators | ISA Intech Magazine                                     | 2003.   |
| - Dr. Guido Carlo-Stella Award                   | World Batch Forum                                       | 2004.   |
| - Process Automation Hall of Fame Inductee       | Control Magazine (at the WBF)                           | 2006.   |
| - Fellow   | International Federation of Automatic Control           | 2011. <a href="http://www.ifac-control.org/awards/ifac-fellows">http://www.ifac-control.org/awards/ifac-fellows</a> |

### Short Biography

Ed. Bristol (Edgar H. Bristol) is a graduate of MIT and Beloit College in Electrical Engineering and Mathematics, with some forty years at the Foxboro Co, now resisting retirement (<http://homepage.mac.com/ebristol/>). He is a well known process control author with some 100 papers and dozen patents in control, adaptive control, multivariable control, and control software and languages. He has participated in a number of Process Control Standards efforts dating back to the beginning of the "Purdue Workshop". He is the originator of RGA analysis and pattern recognition based adaptive control, for which he received the initial IEEE Control Technology Award and similar AIChE and ISA awards, and more recently Swinging Door Data Compression. He is also the 2003 recipient of the ACC Control Technology Award and more recent Batch and Automation Awards. He is currently a fellow of the ISA, and a current or past member of the IEEE, AIChE, ACM, and MAA, having been active nationally and locally in a number of groups within these organizations.

### Publications and Patents

- "Use of Relaxation Oscillator as a Voltage to Frequency Converter", IEEE PTGCT Vol. CT-10, No. 4, December 1963
- "On a New Measure of Interaction for Multivariable Control", IEEE PTGAC, Vol. AC-11, No. 1, January 1966.
- "On a Philosophy of Interaction in a Multiloop World", ISA Chemical & Petroleum Division Chempid Symposium, St. Louis, Missouri, May 1967.
- "A Simple Adaptive System for Industrial Control", Instrumentation Technology, June 1967, pp. 70-74.
- "Compensation for Truncation Errors in Accumulative Addition Using Random Methods", IEEE Transactions on Electronic Computers, Vol. EC-16, No. 4, August 1967. p.518.
- A New Approach to Communications Software" (with G.E. Mahoney, Foxboro),  
1968 JACC, January 1968.
- <sup>(7)</sup> IEEE Transactions on Industrial Electronics, December 1968, pp.22-24.
- "Dynamic Adaptation of Process Controllers by Pattern Recognition" (with G.F.Inaloglu and J.F. Steadman, Foxboro), 1969 JACC, University of Colorado, Boulder, Colorado, August 5-7, 1969.
- "Adaptive Process Control by Pattern Controllers by Pattern Recognition" (with G.F.Inaloglu and J.F. Steadman, Foxboro), Instruments and Control Systems, March 1970, pp. 101-105.
- "Adaptive Control Odyssey", ISA Conference, Philadelphia, Pennsylvania, October 1970, Paper 561-70.
- "Method and Apparatus for Adaptive Control", U.S. Patent No. 3,601,588, August 24, 1971.
- "A Paradox in Multi-Variable Control Analysis", Fourth UKAC Control Convention, September 1, 1971.
- "An Introduction to Process Industry Multivariable Control", 1972 International Conference on Cybernetics and Society (IEEE SMC

- Society), Washington, D.C., October 9-12, 1972.
14. "Method and Apparatus for Compensatory Control of Interacting Process Variables", U.S. Patent No. 3,714,952, February 6, 1973.
  15. "Adaptive Process Control: Versatile On-Line Tool", Control Engineering, Vol. 20, No. 4, April 1973, pp. 41-44.
  16. "Adaptive Process Control: Versatile On-Line Tool - II", Control Engineering, Vol. 20, No. 6, June 1973, pp. 41-43.
  17. "Pattern Evaluation Method and Apparatus for Adaptive Control", U.S. Patent No. 3,789,426, March 19, 1974.
  18. "Adaptation in the Process Industries" (2 hour Plenary), First Annual Adaptive Control Conference, sponsored by Control Engineering and Purdue University, West Lafayette, Indiana, April 29 - May 1, 1974.
  19. "A Query Language for Process Control", 1974 Engineering Foundation Conference on Process Design, Operation, and Control, for Safety and Reliability, New England College, Henniker, New Hampshire, July 21-26, 1974.
  20. "Linear and Nonlinear Effects in Interaction", AIChE Workshop on Industrial Process Control, Tampa, Florida, November 11-13, 1974.
  21. "Review of Process Control Adaptation", 1974 IEEE Conference on Decision and Control, Phoenix, Arizona, November 20-22, 1974.
  22. "The Counter Intuitive Behavior of Complex Systems", IEEE Systems, Man, and Cybernetics Society Newsletter, Vol. 4, No. 1, March 1975.
  23. "Discussion of 'Applying Computers to Time-Dependent Processes', by W.H. Osburne", IEEE Transactions in Industry Applications, Vol. IQ-11, No. 2, March/April 1975, pp. 229--235.
  24. "What Happens When You Decouple -- A Qualitative Analysis", Second Annual Advanced Control Conference, Purdue University, West Lafayette, Indiana, April 28-30, 1975.
  25. "On the Real-Time Supervisory Operating System of the Future", 1975 IFAC/IFIP Workshop on Real-Time Programming, Cambridge, Massachusetts, August 24-30, 1975.
  26. "Pattern Recognition as an Alternative to Parameter Identification in Adaptive Control", IFAC Sixth Triennial World Congress, Cambridge, Massachusetts, August 24-30, 1975.
  27. "Industrial Needs and Requirements for Multivariable Control", 1976 Engineering Foundation Conference on Chemical Process Control, Asilomar, California, January 1976.
  28. "Alarm Analysis Can Diagnose System Faults" (with H.L. Wade), Control Engineering, Vol. 23, No. 2, February 1976, pp. 47-49.
  29. "A Design Study of a Simple Conversation Language System", Automatic Control Division of the American Society of Mechanical Engineers Winter Annual Meeting, New York, December 5, 1976.
  30. "On the Design and Programming of Control Algorithms for DDC Systems", Control Engineering, January 1977.
  31. "Pattern Recognition: An Alternative to Parameter Identification in Adaptive Control", Automatica, Vol. 13, March 1977, pp. 197-202.
  32. "RGA 1977: Dynamic Effects of Interaction", IEEE Decision and Control Conference, New Orleans, Louisiana, December 7-9, 1977.
  33. "Gestalt and Meta Theory in Control Training/Teaching", IFAC, 7th Triennial World Congress, RT 9, Helsinki, Finland, June 1978.
  34. "The Organizational Requirements of the Process Control Distributed System", 1978 JACC, Philadelphia, Pennsylvania, October 1978.
  35. "Recent Results on Interaction in Multivariable Process Control", Seminar on Recent Developments in Control and Estimation, AIChE 71st Annual Meeting, Miami Beach, Florida, November 1978.
  36. "Organization and Discipline for Distributed Process Control", Instrumentation Technology, January 1979, pp. 41-44.
  37. "Small Languages for Large System and Other Uses", 1979 JACC (for IEEE), Denver, Colorado, June 1979.
  38. "Pinned Zeros: An Introduction to Multivariable Zeros and Dynamic Interaction Analysis", ISA Chemical & Petroleum Division Chempid Symposium, Newark, New Jersey, April 1980.
  39. "After DDC - Idiomatic (Structured) control", AIChE 88th National Meeting, Philadelphia, Pennsylvania, June 1980.
  40. "A Philosophical Base for Process Computer Control", ASME Century 2-ETC, International Computer Technology Conference, San Francisco, California, August 1980.
  41. "Strategic Design: A Practical Chapter in a Textbook on Control", 1980 JACC, San Francisco, California, August 1980.
  42. "After DDC, Idiomatic Control", Chemical Engineering Progress, November 1980, pp. 84-89.
  43. "The Right Half Plane'll Get You If You Don't Watch Out", 1981 JACC, University of Virginia, Charlottesville, Virginia, June 17-19, 1981, Paper TA-7A.
  44. "A Batch Language Study" (with B.D. Campbell and A. Gunkler), ISA 81 Fall Conference, Anaheim, California, October 6-8, 1981, Paper C.I. 81-797, pp.394-405.
  45. "Process Control: An Application Theorist's View of Control", IEEE Control Systems Magazine, Vol. 2, No. 1, March 1982, pp. 3-8.
  46. "A Method for the Analysis of Complex Control Schemes" (with A. Prassinis and T.J. McAvoy), 1982 ACC, Arlington, Virginia, June 1982, pp. 1127-1132.
  47. Book Review: [Advanced Control Systems, W. Harmon Ray, McGraw-Hill, New York, 1981], IEEE Transactions on Automatic Control, Vol. AC-27, No. 4, August 1982, pp. 1007-1009.
  48. "Easy to Use Process Control Languages and the Place of Standards", 10th International Meeting of the International Purdue Workshop on Industrial Computer Systems, Purdue University, West Lafayette, Indiana, October 1982.
  49. "The Design of Industrially Useful Adaptive Controllers", ISA/82, Philadelphia, Pennsylvania, October 1982, pp. 569-582, C.i. 82-811.

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52. "Experimental Analysis for Engineering of Adaptive Designs", [Spring National AIChE Meeting](#), Houston, Texas, March 27-31, 1983.
- (53.) in an [AIChE Symposium Series](#) volume edited by G.V. Reklaitis and J.J. Surola, last date April 27, 1983.
- (54.) [Chemical Engineering Progress](#), June 1983.
55. "Experimental Analysis of Adaptive Controllers", [Third Yale Workshop on Applications of Adaptive Systems Theory](#), Center for Systems Science, Yale University, New Haven Connecticut, June 15-17, 1983, pp. 249-253.
56. "A Methodology and Algebra for Documenting Continuous Process Control Systems" (Alternate: "An Algebra of Control Idioms or Intentions"), [1983 ACC](#), San Francisco, California, June 22-24, 1983, Session TP1, pp. 614-622.
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58. "The Design of Language for Application Aptness and Ease of Use", [AIChE National Meeting](#), May 20-23, 1984, Anaheim, California, Paper 5d.
59. "Life with Pattern Adaptation" (with T. Kraus), [1984 ACC](#), San Diego, California, June 6-8, 1984, Session TP3, pp. 888-892.
60. "Standardizing Application Language Systems", [Chemical Engineering Progress](#), August 1984, pp. 65-70.
61. "Modern Control and modern Control", (with J.P. Gerry and P.D. Hansen), [Tenth Annual Advanced Control Conference](#), sponsored by Control Engineering and the Purdue Laboratory for Applied Industrial Control, West Lafayette, Indiana, September 10-13, 1984, pp. 55-170.
62. "What is AI? And Should We Care?", [InTech](#) (ISA Instrument Technology), April 1985, pp.37-44.
63. "Smart Instruments, Artificial Intelligence, and Self Aware Boxes", [ISA Chemid Show](#), Toronto, Ontario, Canada, April 29, 1985.
64. "The EXACT Pattern Recognition Adaptive Controller, a Commercial Success, in English", [Fourth Yale Workshop](#), New Haven, Connecticut, May 29-31, 1985.
65. "Control Teaching and Theory; an Industrial Point of View", [1985 ACC](#), Boston, Massachusetts, June 19-21, 1985, Session FA7.
66. "Expert Systems as a Stimulus to Improved Process Control" (with M. Beaverstock and D. Fortin), [1985 ACC](#), Boston, Massachusetts, June 19-21, 1985, Session TA10.
67. Book Review: [[Chemical Process Control - An Introduction to Theory and Practice](#), George Stephanopolis, Prentice-Hall International Series in Physical and Chemical Engineering Sciences, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1984, pp. 696], [Computers & Chemical Engineering](#), Vol. 9, No. 1, 1985, Pergamon Press, New York, pp. 99-101.
68. "Control Algorithms", [Process Instruments and Controls Handbook](#), 3rd Edition, McGraw Hill book Company, New York, 1985, pp. 17.158-17.175.
69. "A Design Tool Kit for Batch Process Control: Terminology and Structural Model", [InTech](#), October 1985, pp. 47-50.
70. "Idiomatic Control Language", U.S. Patent (+ Corresponding Foreign Patents), October 8, 1985.
71. "How Control Languages Should be Designed, with an Integrated Example Design", [IFAC Real Time Workshop](#), Purdue University, November, 1985.
72. "Once Again Around the Loop: Process Control, Modern Control, and Modern Practice", [12th Annual Advanced Control Conference](#), Purdue University, West Lafayette, IN, September 15-27, 1986.
73. "Languages Designed for Process Control Applications", [1986 ISA Conference](#), Houston, October 13-17, 1986.
74. "Unsolved Problems and Needs of Process Control: A Systems Philosophy View", [AIChE Meeting](#), Miami, November 3-7, 1986.
75. "Data Compression for Display and Storage", U.S. Patent No. 4,669,097 (Serial No. 789531), May 26, 1987.
76. "Moment Projection Feedforward Control Adaptation" (with P.D. Hansen), [1987 ACC](#), Minneapolis, MN, June 10-12, 1987, Session FA10.
77. "The Practical Rationalization of Expert systems", [Proceedings of the 26th IEEE Conference on Decision and Control](#) (IEEE Control Systems Society), Vol. 3, Los Angeles, December 9-11, 1987, Session FA-11, pp. 1948-1953.
78. "Computer Language Structure for Process Control Applications, and Translator Therefore", U.S. Patent No. 4,736,320, April 5, 1988.
79. "Process System Adaptation Beyond Math Models", [International Workshop on Adaptive Control Strategies for Industrial Use](#), Lodge Kankanakis, Alberta, Canada, June 20-22, 1988.
80. "Including the Expert in the System" (with G.R. White), [14th Annual Advanced Control Conference](#), Purdue University, West Lafayette, IN, September 1988.
81. "EXACT and Beyond", [ISA88](#), Houston, Texas, October 16-21, 1988.
82. "Objects, Rules, and Process Control", [1989 ACC](#), Pittsburg, June 21-23, 1989.
83. "An Improved Self-Tuning Controller", U.S. Patent (+ Corresponding Foreign Patents), July 16, 1990
84. "Specification of SuperVariable Open Blocks", [ISA SP50 Working Paper](#), October 24, 1990.
85. "SuperVariable Process Data Definition", [ISA SP50.4 Working Paper](#), Oct. 24, 1990.
86. "Swinging Door Trending: Adaptive Trend Recording?", [ISA90](#), New Orleans, Louisiana, October 14-18, 1990, Paper #90-493, pp. 749-754 in Proceedings.
87. "An Interoperability Level Model: SuperVariable Categories", [ISA SR50 Working Paper](#), July 19, 1991.
88. "SuperVariable Data Typing: Contexts and Discrete Data", [ISA SP50 Working Paper](#), July 25, 1991.

89. "Multivariable Adaptive Feedforward Controller" (with Peter D. Hansen), U.S. Patent No. 5,043,863 (+ Corresponding Foreign Patents), August 27, 1991.
90. "Rules, Statements, and Idioms", 17th Annual Advanced Control Conference, Purdue University, West Lafayette, IN, September 30-October 2, 1991.
91. "Sequencing, Logic, and Theme Statements", Annual AIChE Meeting, Los Angeles, November 17-22, 1991.
92. "Computer Language Structure for Process Control Applications, and Method of Translating Same into Program Code to Operate the Computer", U.S. Patent No. 5,247,693, September 21, 1993.
93. "Even the PID Needs Theory/Software Advances", 1994 International Control Engineering Exposition, 3rd International Control Engineering Conference, McCormack Place, Chicago, March 14-18, 1994.
94. "A Language for Integrated Process Control Application", Retirement Symposium in Honor of Prof. Ted Williams, Purdue University, West Lafayette, IN, Dec. 5-6, 1994.
95. "Local Equipment Controller for Computerized Process Control Applications Utilizing Language Structure Templates in a Hierarchical Organization and Method for Operating the Same", U.S. Patent No. 5,371,895 December 9, 1994.
96. "Not a Batch Language; A Control Language", World Batch Forum, San Francisco, May, 1995; also ISA Transactions, Dec. 1995.
97. "Multivariable Feedforward Adaptive Controller" (with Peter D. Hansen), U.S. Patent No. 5,541,833 (+ Corresponding Foreign Patents), July 30, 1996.
98. "Continuous Control Standards after Field Bus; Why Only 0, 1, and n Make Sense", ISA96, October 1996.
99. "Redesigned State Logic for an Easier to Use Control Language", World Batch Forum, Toronto, May 13-15, 1996; also ISA.
100. "Effective Application of Technical Innovation", ISA97, Anaheim, CA, OCT. 5-9, 1997
101. "Information Models for a Software Future We Never Know", ISA97, Anaheim, CA, OCT. 5-9, 1997
102. "Deriving the Human Interface from the Automatic Controls", Automatic Control Conference, Philadelphia, June 24-26, 1998
103. "Method and Apparatus for Data Compression", U.S. Patent No. 5,774,385, June 30, 1998.
104. "Basic Control Algorithms", Dec. 2, 1998, Update of the earlier "Control Algorithms" for D.M. Considine, Process/Industrial Instruments and Control Handbook, 5th Edition.
105. "Intent-Based Process Control Configuration Models", ISA99, Philadelphia, Oct. 5-9, 1999.
106. "Models and Support for Alarm Operation; Batch vs. Continuous", ISA99, Philadelphia, Oct. 5-9, 1999 (and .).
107. "Improved Process Control Alarm Operation", INTERKAMA99, Duesseldorf, October 1999 (Also given in the same trip at a London conference on Alarm Analysis).
108. "Understanding the PID and Its Tuning", IFAC PID01 Workshop, Terrassa, Spain, April 2000.
109. "A Field Device Language in a Process Control Language Family", ISA2000, New Orleans, Oct. 5-9, 2000.
110. "Idiom Based Documentation of Continuous (Feedback) Process Control", privately distributed, Most Recent Version: Apr. 18, 2001
111. "Simple Single Loop Idiom and Simulation Demo", privately distributed, Most Recent Version: Apr. 11, 2001
112. "Integration of Controlled Industrial Systems with Intent-Based Information Models and Language", SCI 2001, Orlando FL, Jul. 23-26, 2001.
113. "Configurators, Languages, and Graphics", ISA 2001/IMEKO Special Millennium Sessions, Sept 10-13, 2001.
114. "Alarm Analysis Tools Method and Apparatus", U.S. Patent No.: 6,690,274 (Allowed but not Issued, with corresponding foreign patents), March 25, 2002; Issued Feb. 10, 2004.
115. "A Control Retrospective; What We Should Have Done", ISA2002, Chicago IL, Oct. 21-24, 2002.
116. "Idiomatic Control Language", Talk given at LSU Chemical Engineering Dept. on Nov. 1, 2002.

#### Preferred References

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