

## Bernard Friedland

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### Education

Ph.D.	Electrical Engineering	Faculty of Pure Science	Columbia University	1957
M.S.	Electrical Engineering	School of Engineering	Columbia University	1954
B.S.	Electrical Engineering	School of Engineering	Columbia University	1953
A.B.	Pre-engineering	Columbia College	Columbia University	1952

### Academic Honors

National Science Foundation Fellow, 1953-1954

Illig Medal in Applied Science, 1953

Phi Beta Kappa, Tau Beta Pi, Sigma Xi

### Professional Experience

#### Academic

1990 – Present	Distinguished Professor	New Jersey Institute of Technology
1996 – 1997	Lady Davis Visiting Professor	Technion–Israel Institute of Technology
1974 – 1990	Adjunct Professor (Part-time)	Polytechnic University
1970 – 1972	Adjunct Professor (Part-time)	New York University
1967 – 1970	Adjunct Associate Professor (Part-time)	Columbia University
1957 – 1961	Assistant Professor	Columbia University
1954 – 1957	Instructor	Columbia University

#### Industrial

1962 - 1990	Manager, Systems Research	Kearfott Guidance and Navigation Corporation
1961 - 1962	Research Manager	Melpar, Inc.
Summer 1954	Member, Technical Staff	Bell Telephone Laboratories

### Honors and Awards

Rufus Oldenburger Medal, American Society of Mechanical Engineers, 1982

Fellow, Institute of Electrical and Electronics Engineers, 1980

Fellow, American Institute of Mechanical Engineers, 1974

Distinguished Member Award, IEEE Control Systems Society, 1986.

Brooklyn Technical High School Alumni Hall of Fame, 1998.

## Technical Contributions

### Theory

#### *Filtering and Estimation*

Developed new technique for parameter estimation in nonlinear systems.

Developed algorithm for extended Kalman filtering for nonlinear processes with non-gaussian noise.

Used result to develop method for detection and estimation of failures in dynamic systems.

Developed widely-used technique for separating bias estimation in Kalman filters.

Developed technique for estimation of noise variances by use of multiple observers.

Investigated properties of reduced-order Kalman filters and control systems using such filters.

#### *Feedback Control*

Introduced concept of feedback control using state-dependent algebraic Riccati equation.

Developed theory for modeling of dynamic systems for pulsewidth modulation

Developed technique of quasi-optimum control

*Linear modular sequential systems* Studied properties of linear systems over Galois fields, and applications to coding.

*Time-varying discrete-time systems* Work on discrete-time systems with periodically-varying elements anticipated recent work on this topic.

### Applications

#### *Kalman Filtering*

Aided inertial navigation

First published study showing how extended Kalman filter can be used to merge navigation data from several sources.

Trajectory and mass estimation of orbiting and re-entry vehicles

Calibration of inertial navigation systems

#### *Control Systems*

Developed method of friction estimation and compensation.

Studied control and estimation for rapid thermal processing systems.

Investigated application of quasi-optimum control to:

Space vehicle navigation

Control of flexible spacecraft

Design of washout filters for aircraft motion simulators

### ***Inertial Instrumentation***

Investigated dynamics and developed control systems for vibrating-beam gyroscopes.

Co-inventor of vibrating member rate gyro.

Co-inventor of control systems for vibrating-beam rate-integrating gyros.

Studied and developed control systems for ring-laser gyroscopes.

Co-discoverer of anharmonic excitation for reducing random walk in three-axis monolithic ring-laser gyroscope.

Co-inventor of method of controlling mirrors in ring-laser gyroscope.

### **Professional Society Activities**

#### **Control Systems Society, Institute of Electrical and Electronics Engineers**

Vice-President, Conference Activities

Chair, Fellow Nomination Committee

Chair, Fellow Evaluation Committee

Elected Member, Board of Governors (two terms)

#### **Automatic Control Division, American Society of Mechanical Engineers**

Chairman, Executive Committee

Member, Executive Committee

Delegate, Policy Board on Basic Engineering

#### **American Institute of Aeronautics and Astronautics**

Council member, Northern New Jersey Section

#### **American Automatic Control Council**

Chairman, Theory Committee

Delegate, ASME

Delegate, IEEE

Chairman, Eckman Award Subcommittee

#### **Accreditation Board for Engineering and Technology**

Accreditation team member.

### **Editorial Service**

*IEEE Transactions on Automatic Control*

Associate Editor, Applications

Associate-Editor-at-Large

*ASME Journal of Basic Engineering*

Member, Editorial Board

*AIAA Journal of Guidance, Navigation, and Control*

Associate Editor

*IFAC Journal Automatica*

Associate Editor

*Optimal Control Methods & Applications* (John Wiley and Sons)

Member, Editorial Board

## **Grants and Contracts**

NSF Grant MSS 9215636, “Modeling and Compensation of Friction in Control Systems,” \$140,000 from NSF, \$120,000 NJIT matching funds, March 1, 1993 – August 31, 1995.

NSF Grant ECS 9312451, “Estimation and Closed-loop Control for Rapid Thermal Processing,” \$235,000 from NSF, September 1993 – February 1997.

NJ Commission on Science and Technology, “Robotic Vehicle Navigation” \$25,000, July 1, 1992 – June 30, 1993.

NSF Grant ECS 9112004 “Research Equipment Grant: Computer Equipment for Real-Time Parallel Processing,” \$19,000 from NSF, \$9,500 NJIT matching funds. August 1991 – January 1993.

Project Engineer on approximately 25 contracts at Kearfott Guidance and Navigation Corporation from the US Air Force and NASA.

# Publications of Bernard Friedland

## Invited and Plenary Lectures

### B. Friedland, “On the Role of Expert Systems in Control”

- IEEE Distinguished Lecturer Series.  
Published in Proc. VIII Seminario de la Asociacion Chilena de Control Automatico-ACCA: Control de Procesos Industriales, Santiago, Chile, August 23- 25,1989. pp. 1-6.
- Oldenburger Memorial Lecture, Purdue University, West Lafayette, IN,

### B. Friedland, “New Results in Modeling and Compensation of Friction,”

- Plenary Lecture, IEEE Regional Control Conference, Piscataway, NJ, August 1994.
- IEEE Distinguished Lecture Series, Vancouver, BC, April 1995.

## Books

B. Friedland, *Advanced Control System Design*, Prentice-Hall, Upper Saddle River, NJ, 1996.

B. Friedland, *Control System Design: An Introduction to State- Space Methods*, McGraw-Hill Book Company, New York, 1986.

R.J. Schwarz and B. Friedland, *Linear Systems* McGraw-Hill Book Co. New York 1965.

Portuguese edition: *Sistemas Lineares 2 vol.*, AO Livro Tecnico S.A., Rio de Janeiro, 1972.

B. Friedland, O. Wing and R.B. Ash, *Principles of Linear Networks*, McGraw-Hill Book Co., Inc., New York, 1961.

## Book Chapters

B. Friedland, “On Feedback Control of Processes with ‘Hard’ Nonlinearities,” in *Adaptive Control of Nonsmooth Dynamic Systems*, G.Tao and F.L. Lewis (Eds.) Springer-Verlag, London, 2001.

B. Friedland, “Observers,” in *The Control Handbook*, W. Levine, Ed. CRC Press and IEEE Press, 1996, pp. 607–618.

B. Friedland, “Separated-Bias Estimation and Some Applications,” in *Control and Dynamic Systems*, Vol. 20, C.T. Leondes, Ed., Academic Press, New York 1983, pp. 1-45.

Preliminary version included in *Advances in the Techniques and Technology of the Application of Nonlinear Filters and Kalman Filters*, C.T. Leondes, Ed., AGARDograph No. 256, March 1982, pp. 15-1–15-13.)

## General Interest Articles

B. Friedland and P. Dorato, ”A Case for the Doctor of Engineering as a First Professional Degree”, *Engineering Education*, April/May, 1987, pp. 707–713

B. Friedland and P. Dorato, “Doctor of Engineering?” *IEEE Spectrum*, Vol.23, p. 16, December 1986

S. Kahne, H. Sorenson, A. Haddad, B. Friedland, J. Fearnside, and L. Fanning, “U.S. Technology Policy and How it Affects the Control Field, Part I: What It Is and How It Affects Us,” *IEEE Control Systems Magazine*, Vol. 4, No. 3, pp. 14-17, 1984.

## Journal Articles

- A. Berman, J. Dayan and B. Friedland, "Improved EKF Method of Estimating Locations with Sudden High Jumps in the Measurement Noise," *J. of Intell. and Robotic Sys.* Vol. 32, 461-476, 2001.
- B. Friedland, "Introduction to 'Stabilized Feed-Back Amplifiers'," *Proceedings of the IEEE*, vol. 87, No.2, pp. 376-378, February 1999.
- D. Haessig and B. Friedland, "Separate-Bias Estimation with Reduced-Order Kalman Filters," *IEEE Trans. on Automatic Control*, vol. 43, No. 7, pp. 983-987, July 1998.
- J. Amin, B. Friedland, and A. Harnoy, "Implementation of a Friction Estimation and Compensation Technique," *IEEE Control Systems*, pp. 1525-1530, August 1997.
- B. Friedland, "A Nonlinear Observer for Estimating Parameters in Dynamic Systems," *Automatica*, Vol. 33, No. 8, pp. 1525-1530, August 1997.
- A. Harnoy, B. Friedland, and H. Rachoor, "Modeling and Simulation of Elastic and Friction Forces in Lubricated Bearings for Precise Motion Control," *Wear, Journal of Science and Technology*, (Oxford, England) vol. 172, pp. 155-165, 1994.
- A. Harnoy and B. Friedland, "Dynamic Friction of Lubricated Surfaces for Precise Motion Control," *Tribology Transactions*, vol. 37, no. 3, pp. 608- 614, 1994.
- S.E. Mentzelopoulou, G. Antoniou, and B. Friedland, "On a Property of Compensators Designed by the Separation Principle," *IEEE Transactions on Automatic Control*, vol. 38, no. 2, pp. 370-373, February 1993.
- B. Friedland and Y.-J. Park, "On Adaptive Friction Compensation," *IEEE Trans. on Automatic Control*, vol. 37, No. 10, pp. 1609-1612, October 1992.  
(Also in *Proc. 1991 Conference on Decision and Control*, Brighton, England)
- D.A. Haessig, Jr., and B. Friedland, "On the Modeling and Simulation of Friction," *Trans. ASME, Journal of Dynamic Systems, Measurement and Control*, Vol. 113, September 1991, pp. 354-361  
(Also *Proc. 1990 American Control Conference*, San Diego, CA, May 23-25,1990)
- B. Friedland, "On the Properties of Reduced-Order Kalman Filters", (Technical Note) *IEEE Trans. on Automatic Control*, Vol. 34, No. 3, March 1989, pp. 321-324.
- D. Williams, B. Friedland, and A.N. Madiwale, "Modern Control Theory for Design of Autopilots for Bank-to-Turn Missiles", *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 10, No. 4, July-August, 1987, pp.378- 386.
- B. Friedland, J. Richman, and D. E. Williams, "On the 'Adiabatic Approximation' for Design of Control Laws for Linear, Time-Varying Systems", *IEEE Transactions on Automatic Control*, January 1987, Vol. AC-32, No. 1, pp. 62-63.
- B. Friedland, "Maximum Likelihood Failure Detection of Aircraft Flight Control Sensors," *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 5, No. 5, September-October 1982, pp. 498-503.  
(Russian translation published in "Aeronautics/Space Technology," August 1983, pp. 149-156.)
- B. Friedland, "Estimating Noise Variances by Using Multiple Observers," *IEEE Trans. on Aerospace and Electronics Systems*, Vol. AES-10, No. 3, July 1982, pp. 442- 448.
- B. Friedland and S. Grabousky, "Estimating Sudden Changes of Biases in Linear Dynamic Systems," *IEEE Trans. Automatic Control*, Vol. AC- 27, No. 1, February 1982, pp. 237-240.

- B. Friedland, "Discrete-Time Equivalent of Continuous-Time Filtering Processes," *J. Dynamic Systems, Measurement, and Control*, (Trans. ASME, Ser. G.), Vol. 103, No. 6, December 1981, pp. 417-419.
- B. Friedland and R. Kosut, "Effect of Gain Variation on Closed-Loop Roots of Systems Designed by Separation Principle," *IEEE Trans. on Automatic Control*, Vol. AC-26, No. 3, June 1981, pp. 736-739.
- B. Friedland, "Multidimensional Maximum-Likelihood Failure Detection and Estimation," *IEEE Transactions on Automatic Control*, Vol. AC-26, No. 2, April 1981, pp. 567-570.
- B. Friedland, "Steady-State Behavior of Kalman Filter with Discrete-and- Continuous Time Observations," *IEEE Trans. on Automatic Control*, Vol. AC-25, No. 5, October 1980, pp. 988-992.
- B. Friedland, "Maximum-Likelihood Estimation of a Process with Random Transitions (Failures)," *IEEE Trans. on Automatic Control*, Vol. AC-24, No. 6, December 1979, pp. 932-937.
- B. Friedland, "Analysis Strapdown Navigation Using Quaternions," *IEEE Trans. on Aerospace and Electronic Systems*, Vol. AES-14, No. 5, September 1978, pp. 764- 768.
- B. Friedland and M.F. Hutton, "Theory and Error Analysis of Vibrating-Member Gyroscope," *IEEE Trans. on Automatic Control*, Vol. AC-23, No. 4, August 1978, pp. 545-556.
- B. Friedland, "Notes on Separate-Bias Estimation," (Technical Note), *IEEE Trans. on Automatic Control*, Vol. AC-23, No. 4, August 1978, pp. 735-738.
- B. Friedland, "On the Calibration Problem," *IEEE Trans. on Automatic Control*, Vol. AC- 22, No. 6, December 1977, pp. 899-905.
- B. Friedland, "Recursive Filtering in Presence of Biases with Irreducible Uncertainty," (Technical Note), *IEEE Trans. on Automatic Control*, Vol. AC-21, No. 5, October 1976, pp. 789-790.
- B. Friedland, "Modeling Linear Systems for Pulsewidth-Modulated Control," *IEEE Trans. on Automatic Control*, Vol. AC-21, No. 5, October 1976, pp. 739- 746.
- B. Friedland and J. Richman, "Control System Design Using Radioactive Pickoff," *IEEE Trans. on Automatic Control*, Vol. AC-21, No. 4, August 1976, pp. 618- 623.
- B. Friedland, M.F. Hutton, C. Williams, B. Ljung, "Design of Servo for Gyro Test Table Using Linear Optimum Control Theory," (Technical Note), *IEEE Trans. on Automatic Control*, Vol. AC-21, No. 2, April 1976, pp. 293-296.
- B. Friedland, "Controllability Index Based on Conditioning Number," (Technical Brief), *J. Dynamic Systems, Measurement, and Control*, (Trans. ASME, Series G), Vol. 97, December 1975, pp. 444-445.
- B. Friedland, "Estimating Angular Velocity From Output of Rate-Integrating Gyro," *IEEE Trans. on Aerospace and Electronic Systems*, Vol. AES-11, No. 4, July 1975, pp. 551-555.
- M.F. Hutton and B. Friedland, "Routh Approximations for Reducing Order of Linear, Time-Invariant Systems," *IEEE Trans. on Automatic Control*, Vol. AC- 20, No. 3, June 1975, pp. 329-337.
- B. Friedland, "Optimum Steady-State Position and Velocity Estimation Using Noisy Sampled Position Data," *IEEE Trans. on Aerospace and Electronic Systems*, Vol. AES-9, No. 6, November 1973, pp. 906-911.
- B. Friedland and M.F. Hutton, "New Algorithms for Converting LORAN Time Difference to Position," *Navigation*, Summer Issue, Vol. 20, No. 2, 1973, pp. 178-188.
- B. Friedland, "Limiting Forms of Optimum Stochastic Linear Regulators," *Trans. ASME, Series G, J. Dynamic Systems, Measurements and Control*, Vol. 93, September 1971, pp. 134-141.

- B. Friedland, "Treatment of Bias in Recursive Filtering," IEEE Trans. on Automatic Control, Vol. AC-14, No. 4, August 1969, pp. 359-367.
- B. Friedland, "On the Effect of Incorrect Gain in Kalman Filter," IEEE Trans. on Automatic Control, Vol. AC-12, No. 5, October 1967, p. 610.
- B. Friedland, "On Solutions of the Riccati Equation in Optimization Problems," IEEE Trans. on Automatic Control, Vol. AC-12, No. 3, June 1967, pp. 303-304.
- B. Friedland and V. Cohen, "Quasi-optimum Control of a Flexible Booster," Trans. ASME, Series D. Jour. Basic Engineering, Vol. 89, June 1967, pp. 273-282.
- B. Friedland and I. Bernstein, "Estimation of the State of the Nonlinear Process in the Presence of Nongaussian Noise and Disturbances," J. Franklin Institute, Vol. 281, June 1966, pp. 455-480.
- B. Friedland and V. Cohen, "Quasi-Optimum Control for Minimum-Time Rendezvous," IEEE Trans. on Automatic Control, Vol. AC-11, No. 3, July 1966, pp. 525-528.
- B. Friedland, "A Technique of Quasi-Optimum Control", Trans. ASME, Series D, J. Basic Engineering, Vol. 88, June 1966, pp. 437-443.
- B. Friedland, "Optimum Control of an Unstable Booster with Actuator Position and Rate Limits," AIAA Journal, Vol. 3, No. 7, July 1965, pp. 1268- 1274.
- B. Friedland and P.E. Sarachik, "Indifference Regions in Optimum Attitude Control," IEEE Trans. on Automatic Control, Vol. AC-9, April 1964, pp. 180- 181.
- H. O. Ladd, Jr. and B. Friedland, "Minimum Fuel Control of Second- Order Linear Process with a Constraint on Time-to-Run", Trans. ASME, Series D, J. Basic Engineering, Vol. 86, March 1964, pp. 160-168.
- B. Friedland, "The Design of Optimum Controllers for Linear Processes with Energy Limitations," Trans. ASME, Series D, J. Basic Engineering, Vol. 85, No. 2, June 1963, pp. 181-196.
- B. Friedland, "The Structure of Optimum Control Systems," Trans. ASME, Series D, J. Basic Engineering, Vol. 84, March 1962, pp. I- 1 2.
- B. Friedland, "A Minimum Response-Time Controller for Energy and Amplitude Constraints," IRE Trans. on Automatic Control, Vol. AC-7, No. 1, January 1962, pp. 73-74.
- B. Friedland and T.E. Stern, "The Linear Modular Sequential Circuit Generalized," IRE Trans. on Circuit Theory, Vol. CT-8, March 1961, pp. 79-80.  
(Included in Linear Sequential Switching Circuits: Selected Technical Papers, H. Kautz, Ed., Holden-Day, Inc., San Francisco, 1965.)
- B. Friedland and T. E. Stern, "On Periodicity of States in Linear Modular Sequential Circuits," IRE Trans. of Information Theory, Vol. IT-5, September 1959, pp. 136-137.
- T.E. Stern and B. Friedland, "Application of Modular Sequential Circuits to Single Error- Correcting P-Nary Codes," IRE Trans. on Information Theory, Vol. IT-5, No. 3, Sept. 1959, pp. 114-123.  
(Included in Linear Sequential Switching Circuits: Selected Technical Papers, H. Kautz, Ed., Holden-Day, Inc., San Francisco, 1965.)
- B. Friedland, "Modular Sequential Circuits," IRE Trans. on Circuit Theor Vol. CT-6 No. 1 March 1959, pp. 61-68.
- B. Friedland, "Least Squares Filtering and Prediction of Nonstationary Sampled Data," Information and Control, Vol. 1, No. 4, December 1959, pp. 297-313.



- B. Friedland, "Time Varying Analysis of a Guidance System," *Trans. AIEE*, Vol. 75, Pt. 11, May 1958, pp. 75-81.
- B. Friedland, "Analysis of a Tuned Power Amplifier," *Columbia Engineering Quarterly*, Vol. 10, No. 2, January 1957, pp. 22-24.
- B. Friedland, "A Technique for the Analysis of Time-Varying Sampled-Data Systems," *Trans. AIEE*, Vol. 74, Pt. II, January 1957, pp. 407-414.

## Refereed Conference Papers

- B. Friedland, "Time-Domain Filtering and Control with Empirical Data," *Proceedings, 2002 IFAC Congress, Barcelona, Spain, July 21-26, 2002.*
- D.A. Haessig and B. Friedland, "State-Dependent Differential Riccati Equation for Nonlinear Estimation and Control," *Proceedings, 2002 IFAC Congress, Barcelona, Spain, July 21-26, 2002.*
- D.A. Haessig and B. Friedland, "Nonlinear Reduced-Order State and Parameter Observer," *Proc. American Control Conference, Arlington, VA, June 21-23, 2001.*
- B. Friedland, "Smart Integral Control," *Proc. American Control Conference, San Diego, CA, June 1999.*
- B. Friedland, "Aspects of Traction Control," *Proc. Seventh Mediterranean Control Conference, Haifa, Israel, June 1999.*
- S. Lyshevsky, V. Pappano, and B. Friedland, "Nonlinear Identification of Induction Motor Parameters," *Proceedings, 1998 IEEE Conf. on Decision and Control, Tampa, FL, December 16-18, 1998.*
- V. Pappano, S.E. Lyshevski, and B. Friedland, "Parameter Identification of Induction Motors," *Proc. IEEE Conf. on Control Applications, Trieste, Italy, September 1998, pp. 470-474.*
- V. Pappano and B. Friedland, "Analytical Solution for a Separate State and Parameter SDRE Observer for a CSI-fed Induction Motor," *Proc. IEEE Conf. on Control Applications, Trieste, Italy, September 1998, pp. 1286-1291.*
- B. Friedland, "On Controlling Systems with State-Variable Constraints," *Proc. 1998 American Control Conf., Philadelphia, PA, June 4-6, 1998.*
- V. Pappano and B. Friedland, "Speed Sensorless Observer for an Induction Machine," *Proc. American Control Conference, Albuquerque, NM, June 4-6, 1997. pp. 3805-3806.*
- B. Friedland, "Feedback Control of Systems with Parasitic Effects," *Proc. American Control Conference, Albuquerque, NM, June 4-6, 1997.*
- D. Yang and B. Friedland, "Decentralized Control Strategy for an Agonistic System," *Proc. American Control Conference, Albuquerque, NM, June 4-6, 1997, pp. 2386-2387*
- P. Gurfil, I.G. Shaviv, and B. Friedland, "On a Lipschitzian Dynamic Model of a Simple Hysteresis," *Proc. 36th IEEE Conf. on Decision and Control, San Diego, CA, Dec. 10-12, 1997, pp. 1168-1169.*
- S. Belikov, J. Kamali, and B. Friedland, "A State Dependent Riccati Equation Filter for a Rapid Thermal Processing System," *Proc. 36th IEEE Conf. on Decision and Control, San Diego, CA, Dec. 10-12, 1997, pp. 2547-2548.*
- D. Yang and B. Friedland, "Two Dimensional Agonistic Control with Elastic Tendons," *Proc. Japan/USA Symposium on Flexible Automation, July 7-10, 1996, pp. 95-101.*
- El-Roy, A. and Friedland, B., "Precision Single-Axis Control System with Friction Compensation," *Proceedings, 1995 American Control Conference, Seattle, Washington, June 21-23, 1995.*

- S. Belikov, M. Kaplinsky, and B. Friedland, "Parameter Estimation for Evaluating Ability of a Rapid Thermal Processing System to Maintain Uniform Temperature," Proceedings, 1995 IEEE Conference on Control Applications, Albany, NY, September 28-29, 1995.
- B. Friedland and W. Grossman, "On Controlling Continuous-Time Processes with Data on Occurrence of Discrete Events," Proceedings, 1995 IEEE Conference on Control Applications, Albany, NY, September 28-29, 1995.
- S. Belikov, M. Kaplinsky, and B. Friedland, "Parameter Estimation in a Dynamic Model for Rapid Thermal Processing: Theory and Experimental Results," ) Proceedings, 1995 American Control Conference, Seattle, Washington, June 21-23, 1995.
- A. El-Roy and B. Friedland, "Precision Single-Axis Control System with Friction Compensation," Proceedings, 1995 American Control Conference, Seattle, Washington, June 21-23, 1995.
- S.E. Mentzelopoulou and B. Friedland, "Experimental Evaluation of Friction Estimation and Compensation Techniques," Proceedings, 1994 American Control Conference, Baltimore, Maryland, June 29-July 1, 1994.
- A. Harnoy, B. Friedland, A. Aly, R. Semenoek, and H. Rachoor "Apparatus for Empirical Determination of Dynamic Friction," Proceedings, 1994 American Control Conference, Baltimore, Maryland, June 29-July 1, 1994.
- B. Friedland and S.E. Mentzelopoulou, "On Estimation of Dynamic Friction," Proceedings, 1993 Conference on Decision and Control, San Antonio, TX, December, 1993.
- B. Friedland and H. Ding, "On Navigation of a Robotic Land Vehicle," Proceedings 1993 AIAA Guidance and Control Conference, Monterey, California, August 9-11, 1993.
- B. Friedland, "A Simple Nonlinear Observer for Estimating Parameters in Dynamic Systems," Proceedings, 1993 IFAC Congress, Sydney, Australia, July 18- 23, 1993.
- S.E. Mentzelopoulou, B. Friedland, and Y.-J. Park, "Friction Estimation in Multi-Mass Systems," Proceedings, 1993 American Control Conference, San Francisco, CA, June 2-4, 1993.
- B. Friedland and S.E. Menzelopoulou, "On Adaptive Friction Compensation without Velocity Measurement," Proceedings, 1st IEEE Conference on Control and Applications, Dayton, OH, September 13-16, 1992.
- B. Friedland, "An Observer-Based Design of a Controller for Spring- Coupled Cars," Proc. 1992 American Control Conference, Chicago, IL June 24-26, 1992, pp. 2053-2054.
- B. Friedland, "On Estimation of Noise Variances in Linear Dynamic Systems," Presented at 5th IEEE Intl. Symposium on Intelligent Control, Philadelphia, PA, September 5-7,1990.
- W. Grossman, F. Khorrami, and B. Friedland, "An Observer-Based Design for Robust Control of Robot Manipulators," Proc. 1990 American Control Conference, San Diego, CA, May 23-25,1990.
- B. Friedland, "Another Beam Deflection Control System Design," Proc. IEEE International Conference on Control and Applications," Jerusalem, Israel, April 3-6,1989, Paper RP-1-1.
- D.E. Williams and B. Friedland, "Target Maneuver Detection and Estimation," Proc. 27th Conf. on Decision and Control, Austin, TX, December 7-9,1988, Vol. 1, pp. 851-855.
- D.E. Williams, J. Richman, and B. Friedland, "Integrated Guidance and Control for Combined Command/Homing Guidance," Proc. 1988 American Control Conference, Atlanta, GA, June 15-17,1988, Vol. 1, pp.549-554.

- J. Richman, D. Haessig, Jr., and B. Friedland, "Integrated Strapdown Avionics for Precision Guided Vehicles", Proc. 1986 Position Location and Navigation Symposium [PLANS], Las Vegas, NV, November 4-7, 1986, pp. 476-480.
- J. Richman, D. A. Haessig, Jr., and B. Friedland, "Integrated Strapdown Avionics for Precision Guided Weapons", Proc. 1985 American Control Conference, Boston, MA, June 19-21, 1985, Vol. 1, pp. 330-334.  
Also in Control Systems Magazine, Vol. 6, No. 3, June 1986, pp. 9-12.
- D.A. Haessig, Jr. and B. Friedland, "Maximum Likelihood Estimation of Target Acceleration", Proc. IEEE Conf. on Decision and Control, Las Vegas, NV, Dec. 12-15, 1984, Vol. 3, No. 3, pp. 1398-1402.
- B. Friedland, "Control of Linear Systems in Parallel," Proc. Conference on Decision and Control, San Antonio, TX, 14-16 December 1983, pp. 384-388.
- D. Williams, J. Richman, and B. Friedland, "Design of an Integrated Navigation, Guidance, and Control System for Tactical Missiles," Proc. AIAA Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, pp. 57-66.
- A.N. Madiwale and B. Friedland, "Comparison of Innovations-Based Failure Detection and Correction Methods," Proc. American Control Conference, Vol. 3, San Francisco, CA, June 22-24, 1983, pp. 940-945.
- S. Welt and B. Friedland, "Quasi-Optimum Control for Minimum Time Rendezvous in a Central Force Field," Preprints of Papers, 1969 Joint Automatic Control Conference, Boulder, CO, August 1969, pp. 831-842.
- S. Welt and B. Friedland, "Application of a Quasi-Optimum Control Technique to Orbital Injection Guidance," Presented at AIAA Guidance, Control and Flight Dynamics Conference, Pasadena, CA, August 1968, AIAA paper 68-870.
- F.E. Thau, J. Tavantzis, and B. Friedland, "Quasi-Optimum 3-Axis Attitude Control of a Space Vehicle," presented at the 2nd IFAC Symposium on Automatic Control in Space, Vienna, (Austria), September 1967.
- J. Richman and B. Friedland, "Design of Optimum Mixer-Filter for Aircraft Navigation Systems," Proc. of National Aerospace Electronics Conference, Dayton, OH, May 1967, pp. 429-438.
- B. Friedland, F.E. Thau, and P. E. Sarachik, "Stability Problems in Randomly-Excited Dynamic Systems," Preprints of Papers, 1966 Joint Automatic Control Conference, Seattle, WA, August 1966, pp. 848-861.
- B. Friedland and P.E. Sarachik, "A Unified Approach to Suboptimum Control," Proc. 3rd Congress International Federation of Automatic Control, Basle, Switzerland, June 1966, pp 848-861.
- B. Friedland, "Optimum Control of Discrete-Time Dynamic Processes," Proc. 2nd Congress International Federation of Automatic Control, Basle, Switzerland, August 1963, pp. 410/1-410/6.
- B. Friedland, "Sampled-Data Control Systems Containing Periodically Varying Members," Proc. First Congress International Federation of Automatic Control, Moscow, 1960, Butterworths Scientific Publishers, London, 1960, pp. 139-146.
- B. Friedland and T.E. Stern, "Linear Modular Sequential Circuits and Their Application to Multiple Level Coding," IRE National Convention Record, Pt.II, 1959, pp. 40-48.

## Conference Papers

- V. Pappano and B. Friedland, "SDRE Observer for an Induction Machine," Proc. IASTED International Conference on High Technology in the Power Industry, Orlando, FL, October 27-30, 1997, pp. 254-257.
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