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## **1. Personal**

Born: July 3, 1955, Lubumbashi (Democratic Republic of Congo)  
Citizenship: USA (Naturalized)  
Married, three children.

## **Education**

1981: Ph.D. in Mechanical Engineering, Columbia University, New York NY 10027  
Ph.D. Thesis Title: Contributions to Reduced Order Control Theory  
Ph.D. Advisor: Prof. Richard W. Longman

1977: Ingénieur Civil en Mathématiques Appliquées  
Université Catholique de Louvain, B-1348 Louvain-la-Neuve, Belgium

## **Employment**

January 1997 - July 1997  
Visiting Scientist, Scientific Research Laboratories, Ford Motor Company,  
Dearborn

September 1990 - December 1990  
Visiting Professor, Unité d' Automatique et Dynamique des Systèmes,  
Université Catholique de Louvain

September 1994 - Present:  
Professor of Aerospace Engineering, The University of Michigan

September 1989 - August 1994:  
Associate Professor of Aerospace Engineering, The University of Michigan

January 1984 - August 1989:  
Assistant Professor of Aerospace Engineering, The University of Michigan

October 1983 - December 1983:  
Lecturer of Aerospace Engineering, The University of Michigan

September 1981 - July 1983:  
Assistant, Unité de Mécanique Appliquée, Université Catholique de Louvain

September 1979 - September 1981:  
Research Assistant, Mechanical Engineering Dept., Columbia University

September 1977 - September 1979:  
Assistant, Unité de Mécanique Appliquée, Université Catholique de Louvain

## 2. Publications

### Refereed Journals (70)

P. T. Kabamba, S. M. Meerkov and C. Y. Tang, "Ranking and Adaptive Ranking CDMA," to appear in *IEEE/ACM Transactions on Networking*, 2005

H. Mahmoud, P. Kabamba, A. G. Ulsoy and G. Brusher, "Target Management in Complex System Design Using System Norms," to appear in the *Journal of Mechanical Design*.

P. T. Kabamba, S. M. Meerkov and C. Y. Tang, "Control and Adaptation of TDMA in Wireless Networks," to appear in *Dynamics of Continuous, Discrete and Impulsive Systems*.

S. Chakravorty, P. T. Kabamba and D. C. Hyland, "Guaranteed Classification Performance of Multi-Spacecraft Interferometric Imaging Systems," *Journal of the Astronautical Sciences*, Vol. 51, No. 2, pp. 205-226, April-June 2003

Y. Eun, P. T. Kabamba and S. M. Meerkov, "Tracking of Random References: Random Sensitivity Function and Tracking Quality Indicators," *IEEE Transactions on Automatic Control*, Vol. 48, No. 9, pp. 1666-1671, September 2003

Y. Eun, P. T. Kabamba and S. M. Meerkov, "System Types in Feedback Control with Saturating Actuators," *IEEE Transactions on Automatic Control*, Vol. 49, No. 2, pp. 287-291, February 2004

Y. Eun, C. Gokcek, P.T. Kabamba and S.M. Meerkov, "An LQG Approach to Systems with Saturating Actuators and Anti-Windup Implementation," *Mathematical Problems in Engineering*, Vol 8(4-5), pp. 311-321, 2002.

P.T. Kabamba, S.M. Meerkov, W.E. Stark and C.Y. Tang, "Feedforward Control of Data Rate in Wireless Networks," *IEEE Trans. Vehic. Technol.*, Vol. 51, No. 5, pp. 1206-1222, September 2002.

A. Dogan and P.T. Kabamba, "Modified Guidance Laws to Escape Microburst with Turbulence," *Mathematical Problems in Engineering*, Vol 8, pp. 43-67, 2002.

C. Gokcek, P.T. Kabamba, and S.M. Meerkov, "An LQR/LQG Theory for Systems with Saturating Actuators," *IEEE Trans. Auto. Contr.*, Vol. 46, No 10, pp. 1529-1542, 2001.

Eun, Y., Kabamba, P.T., and Meerkov, S.M., "Improvability of Feedback Systems," *J. Math. Anal. Appl.*, Vol. 251, No 2, pp. 912-928, Nov. 2000.

Dogan, A., and Kabamba, P. T., "Escaping a Microburst with Turbulence: Altitude, Dive and Pitch Guidance Strategies," *J. Aircraft*, Vol. 37, No. 3, pp. 417-426, May-June 2000

C. Gokcek, P.T. Kabamba and S.M. Meerkov, "Analysis of H2 Performance Robustness with Respect to Disturbance Model Uncertainty", *IEEE Trans. Automat. Contr.*, Vol. 45, No. 8, pp. 1541-1544, June 2000

Park, J., Rhinehart, R.G., and Kabamba, P.T., "Miss Analysis in Lambert Interceptions with Application to a New Guidance Law", *Math. Prob. Eng.*, Vol. 6, pp. 225-265, 2000

C. Gokcek, P.T. Kabamba, and S.M. Meerkov, "Optimization of Disturbance Rejection in Systems with Saturating Actuators," *J. Math. Anal. Appl.*, Vol. 249, pp. 135-159, 2000

D.E. Davison, P.T. Kabamba, and S.M. Meerkov, "Robustness with Respect to Disturbance Model Uncertainty: Theory and Application to Autopilot Performance Analysis." *Math. Prob. Eng.*, Vol. 6, pp. 267-304, 2000

C. Gokcek, P.T. Kabamba, and S.M. Meerkov, "Disturbance Rejection in Control Systems with Saturating Actuators," *Nonlin. Anal.*, Vol. 40, pp. 213-226, 2000

N.X. Vinh, P.T. Kabamba, and T. Takehira, "Optimal Interception of a Maneuvering Long-Range Missile," *Acta Astronautica*, Vol. 48, No. 1, pp. 1-19, 2001

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Davison, D.E., Kabamba, P.T., and Meerkov, S.M., "Limitations of Disturbance Rejection in Feedback Systems with Finite Bandwidth," *IEEE Trans. Auto. Contr.* Vol 44, No 6, pp. 1132-1144, June 1999.

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Davison, D.E., Kabamba, P.T., and Meerkov, S.M., "The V-Transform: A Tool for Analysis of Control Systems Robustness with Respect to Disturbance Model Uncertainties," *Math. Probl. Eng.*, Vol. 3, No 5, pp. 413-477, 1998.

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Ben Amara, F., Venugopal, R., Kabamba, P.T., Ulsoy, A.G., and Bernstein, D.S., "A Comparison of Two Adaptive Algorithms for Disturbance Cancellation," *Annual Reviews in Control*, Vol. 21, pp. 67-78, 1997.

Ling, J., Kabamba, P.T. and Taylor, J., "Multicriterion Structure/Control Design for Optimal Maneuverability and Fault Tolerance of Flexible Spacecraft," *J. Opt. Th. Appl.*, Vol. 82, No 2, pp. 219-251, July 1994.

Kabamba, P.T., Meerkov, S. M., and Poh, E.-K., "  $H_2$  - Optimal Zeros," *IEEE Trans. Auto. Contr.*, Vol. 39, No. 6, pp. 1298-1301, June 1994.

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Kabamba, P. T., "Control of Linear Systems Using Generalized Sampled-Data Hold Functions," *IEEE Trans. Auto. Contr.*, Vol. AC-32, No. 9, pp. 772-783, 1987.

Kabamba, P. T. and Shin, K.-C., "A Comparison of Local Pole Assignment Methods," *J. of Guidance, Control and Dynamics*, Vol. 9, No. 6, pp. 719-722, November-December 1986.

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Kabamba, P. T., "Balanced Forms: Canonicity and Parametrization," *IEEE Trans. Auto. Contr.*, Vol. AC-30, No. 11, pp. 1106-1109, November 1985.

Kabamba, P. T., "Balanced Gains and Their Significance for L<sub>2</sub> Model Reduction," *IEEE Trans. Auto. Contr.*, Vol. AC-30, No. 7, pp. 690-693, July 1985.

Guillaume, A. M. and Kabamba, P. T., "Optimal Finite Horizon Approximation of Unstable Linear Systems," *J. of Guidance, Control, and Dynamics*, Vol. 8, No. 2, pp. 278-280, March-April 1985.

Kabamba, P. T. and Longman, R. W., "An Integrated Approach to Reduced Order Control Theory," *Optimal Control Applications and Methods*, Vol. 4, pp. 405-415, 1983.

Kabamba, P. T. and Longman, R. W., "Exact Pole Assignment Using Direct or Dynamic Output Feedback," *IEEE Trans. Auto Contr.*, Vol. AC-27, No. 6, pp. 1244-1246, December 1982.

Kabamba, P. T., "Model Reduction by Euclidean Methods," *J. of Guidance and Control*, Vol. 3, pp. 555-562, November-December 1980.

## Conferences & Proceedings (111)

H. Fukuzawa, and P.T. Kabamba, "Probabilistic Control of Linear Periodic Systems Using Generalized Sampled-Data Hold Functions," Proc American Control Conference, Denver, Colorado, June 2003

H. Mahmoud, P.T. Kabamba, A.G. Ulsoy and G. Brusher, "Ranking Subsystem Targets According to Their Influence on System Performance," Proc American Control Conference, Denver, Colorado, June 2003

Y. Eun, P.T. Kabamba, and S.M. Meerkov, "System Types and Feedback Control with Saturating Actuators," Proc American Control Conference, Denver, Colorado, June 2003

V. Rao and P.T. Kabamba, "Time-Optimal Traversal for Two Agents: When is Formation Travel Beneficial?" Proc American Control Conference, Denver, Colorado, June 2003

Rao, V. and Kabamba, P.T., "NRASIM: A Design Toolbox for Scheduling of Multi-Spacecraft Interferometric Telescopes," Proc AIAA Modeling and Simulation Technologies Conference, Austin, Texas, August 2003

Kabamba, P.T., Meerkov, S.M., and Tang, C.Y., "Optimal, Suboptimal and Adaptive Threshold Policies for Power Efficiency of Wireless Networks," Proc 2003 IEEE International Conference on Communication, Anchorage, Alaska, May 2003

Rao, V. and Kabamba, P.T., "Interferometric Observatories in Circular Orbits: Designing Constellations for Capacity, Coverage and Utilization," Proc 2003 AAS/AIAA Astrodynamics Specialists Conference, Big Sky, Montana, August 3-7, 2003

Eun, Y., Kabamba, P.T., and Meerkov, S.M., "Tracking of Random References: Random Sensitivity Function and Tracking Quality Indicators," Proc 2003 CDC.

Kumar, R., Hyland, D.C., and Kabamba, P.T., "Probability Model for an Adaptive Random Search Algorithm," Proc 2003 CDC.

Mahmoud, H., Kabamba, P.T., Ulsoy, A.G., and Brusher, G., "The Setting and Management of Design Targets in Complex Systems Using System Norms: Extension to Multiple Attributes," Proc 2003 ASME International Mechanical Engineer Conference and Exhibition.

S. Chakravorty, P. T. Kabamba and D. C. Hyland, "Design of Minimum Time Maneuvers for Multi-Spacecraft Interferometric Imaging Systems," Proc of SPIE Conference on Modeling and Systems Engineering for Astronomy, Glasgow, Scotland, June 21-25, 2004.

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S. Chakravorty, P.T. Kabamba, and D.C. Hyland, "Optimal Mean Squared Error Imaging," Paper AIAA-2002-4952, Proc AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug 2002

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Y. Eun, C. Gokcek, P.T. Kabamba, and S.M. Meerkov, "An LQG Approach to Systems with Saturating Actuators and Anti-Windup Implementation," Proc 2002 IFAC Conference, pp. ?? Barcelona, Spain

H. Fukuzawa, and P.T. Kabamba, "Probabilistic Controller Analysis and Synthesis for Quadratic Performance: The Method of HPD Inscription," Proc American Control Conference, Anchorage, Alaska, pp. 4244-4249, May 2002.

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H.A. Mahmoud, P.T. Kabamba, A.G. Ulsoy, and G.A. Brusher, "Target Reduction and Balancing Using System Norms: Application to Vehicle Design," Proc ASME International Mechanical Engineer Conference and Exhibition, New Orleans, Nov 2002

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Y. Eun, P.T. Kabamba, and S.M. Meerkov, "Improvability of Feedback Systems with Saturating Actuators and Noisy Sensors," American Control Conference, Arlington, VA, pp. 89-94, June 2001.

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"Contributions to Reduced Order Control Theory," Ph.D. Dissertation, Columbia University, New York NY, 1981.

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### **3. Doctoral Supervision (22)**

Aslaug Haraldsdottir: "Performance Improvement by Derivative Feedback in Linear Systems," Co-Chair with A. G. Ulsoy. Defended February 4, 1987.

Yeo-Chow Juan: "Generalized Sampled-Data Hold Function Control of Linear Systems." Defended May 26, 1988.

Gurkirpal Singh: "Time-Optimal Maneuvers of Flexible Spacecraft," Co-Chair with N. H. McClamroch. Defended July 18, 1988.

Kyung-Chul Shin: "Force and Motion Control in Constrained Dynamical Systems," Co-Chair with A. G. Ulsoy. Defended July 18, 1988.

Chang Yang: "Robust Control of Linear Systems Using Generalized Sampled-Data Hold Functions." Defended August 16, 1990.

Tan Kok Tin: "Nonlinear Feedback Controls for Discrete-Time Systems with Generalized State and Control Constraints," Co-Chair with E. G. Gilbert. Defended July 19, 1991.

Shuoh Rern: "Stability Robustness Analysis and Design under Parametric Uncertainties." Defended September 1991.

Yao-Shan Hung: "Assignment of Nonlinear Sampled-Data System Dynamics Using Generalized Hold Function Control." Defended December 1991.

Jer Ling: "Design of Elastic Structures for Optimal Maneuverability," Co-Chair with J. E. Taylor. Defended December 1991.

Eng-Kee Poh: "Closed Loop Vibrational Control: Theory and Applications," Co-Chair with S. M. Meerkov. Expected Date of Defense: Defended May 1993.

Gerald Brusher (MEAM): "Simultaneous Modeling and Control of Flexible Systems," Co-Chair with Galip Ulsoy. Expected Date of Defense: Summer 1993.

Eric Hamby (Aero): "A Bayesian Approach to Modeling and Control," Co-Chair with P.P. Khargonekar. Defended June 1998.

Joonhyung Park (Aero): "Miss Distance Analysis in Homing and Lambert Interceptions with Application to a New Guidance Law," Defended August 1999.

Daniel E. Davison (EECS): "Robustness of Disturbance Attenuation with Respect to Disturbance Model Uncertainty," Co-Chair with S.M. Meerkov. Defended October 1997.

Tetsuya Takehira (Aero): "A New Guidance Law for Three-Dimensional Interception of a Maneuvering Target," Co-Chair with N.X. Vinh. Defended May 1998.

Foued Ben Amara (MEAM), "Adaptive Sinusoidal Disturbance Rejection in Linear Systems with Application to Noise Cancellation" Co-chair with Galip Ulsoy, Defended November 1997.

Atilla Dogan (Aero), "Guidance Strategies for Microburst Escape," Defended May 15, 2000

Cevat Gokcek (EECS), "Disturbance Rejection and Reference Tracking in Control Systems with Saturating Actuators," Co-Chair with S.M. Meerkov, Defended May 31, 2000

Choon-Yik Tang (EECS), "Power Efficient Transmission Protocols for Wireless Networks," Co-Chair with Semyon Meerkov, Defended April 4, 2003

Yongsoo Eun (EECS), "Reference Tracking in Feedback Control With Saturating Actuators," Co-Chair with Semyon Meerkov, Defended August 21, 2003

Venkatesh Rao (Aero), "Team Formation and Breakup in Multiagent Systems," Defended December 3, 2003

Suman Chakravorty (Aero), "Design and Optimal Control of Multi-Spacecraft Interferometric Imaging Systems," Co-Chair with David Hyland, Defended March 5, 2004

#### **4. Sponsored Research**

"Real Time Simulation of Land Vehicle Dynamics," with R. M. Howe and D. T. Greenwood, \$56,000 (1 year), funded by General Dynamics.

"Continued Research on Land Vehicle Simulation," with R. M. Howe and D. T. Greenwood, \$24,923 (7 months), funded by General Dynamics.

"Generalized Sampled-Data Hold Function Control," \$131,552 (2 years), funded by N.S.F.

"Vibrational Control of Rotorcraft Systems," with S. M. Meerkov, \$19,680 (7 months), funded by USARO.

"Vibrational Control Phenomena in Rotorcraft Dynamics," with S. M. Meerkov, \$268,806 (3 years), funded by USARO.

"The Development of Theory and Design Methodology for Robust Controller in the Parameter Space," with A. Olbrot and M. Polis (both from Wayne State U.), \$199,980 (2 years), funded by NSF.

"  $H_2$  -Optimal Actuators and Sensors Placement in Mechanical Systems," with, S.M. Meerkov, funded by USARO, \$93,981, 6-1-92 to 5-31-95

"Closed Loop Vibrational Control: Theory and Application," with S.M.Meerkov, funded by USARO, \$285,000, 1-1-90 to 5-31-93

"Sensor Based Control of Semiconductor Equipment," with Elta, M., Freudenberg, J.S., Giles, M.D., Grizzle, J.W., Khargonekar, P.P., Lafortune, S., Meerkov, S.M., Teneketzi, D., and Terry, F.L., funded by NSF, \$500,189, 9-1-92 to 8-31-95

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System Decomposition and Requirements Definition, Ford Motor Company, \$95,734, N002759, 3/1/2001-12/31/2001 (No-cost extension to 12/31/2002), with A.G. Ulsoy

Feedforward Control of Data Rate in Wireless Networks, NSF, \$299,998, ANI-0106716, 9/15/01-8/31/04, with S.M. Meerkov

Quasi-Linear Control, NSF, \$319,976, CMS-0323953, 9/01/03-8/31/06, with S.M. Meerkov

## 5. Other

### Teaching Experience

From September 1977 to September 1979, and September 1981 to September 1983, I was employed by the University of Louvain as "Assistant." My time was shared between conducting discussion sessions, teaching laboratories and doing research. I have developed tutorial experience in the following fields: Newtonian, Eulerian, Lagrangean and Hamiltonian Mechanics, Continuum Mechanics, Elementary Fluid Mechanics, Classical Control, Calculus of Variations, Optimal Control, Linear Algebra, and Advanced Calculus.

From October 1983 to the present at The University of Michigan, I have been teaching courses in the areas of Dynamics and Control. More specifically, I have taught the following courses:

- Linear Dynamical Systems (graduate level)
- Optimal Control (graduate level)
- Special Topics in Systems Theory (graduate level, I introduced it)
- Advanced Dynamics (graduate level)
- Control of Aerospace Structures (graduate level, I introduced it)
- Guidance and Navigation (graduate level, I performed a major revision)
- Linear Algebra and Matrix Theory (senior/graduate level)
- Digital Control (graduate level)
- Automatic Control Systems (senior/graduate level)
- Flight Dynamics (Junior level)
- Flight Dynamics and Control (Junior level, I introduced it)
- Space System Design (senior/graduate level)
- Astrodynamics (graduate level)

Moreover, I have organized a Student Seminar Series/Journal Club in Dynamics and Control. This provides a forum for graduate students to present their research and be exposed to the work and ideas of their colleagues. This series has gained wide acceptance among our graduate students.

### Research Experience and Interests

From September 1977 to September 1979 in Louvain-la-Neuve, I worked on problems of dynamics of deformable multibody systems. In particular, I automated the computation of integrals coupling deformation and attitude variables which intervene in the equations of motion. I also worked on model reduction methods.

From September 1979 to September 1981 at Columbia, I worked on problems of reduced order control of large systems, which was the subject of my dissertation.

From September 1981 to September 1983 in Louvain-la-Neuve, I worked on problems of reduced order control theory and model reduction. I directed a (MS level) thesis on model reduction.

From October 1983 to the present at the University of Michigan, I have done research in the areas of Systems and Control theory.

My current interests are in the area of linear and nonlinear dynamic systems, robust control, guidance and navigation, and intelligent control. My recent research activities have

aimed at the development of *quasi-linear control theory*, that is applicable to linear plants with nonlinear sensors or actuators. I have also done work in the *design, scheduling and operation of multi-spacecraft interferometric imaging systems*, to be used to obtain images of exo-solar planets. Moreover, I have also done work in the *analysis and optimization of random search algorithms*. Finally, I am also doing work in *simultaneous path planning and communication scheduling for UAVs* under the constraint of radar avoidance.

### **Awards and Honors**

Graduated *Summa Cum Laude* with a degree in Applied Mathematics Engineering from the University of Louvain, 1977.

Awarded the *Mechanical Engineering Departmental Fellowship* at Columbia University in 1979-1980 and 1980-1981.

*Distinguished Service Award*, from the Class of 1938E, May 1988, College of Engineering, The University of Michigan.

*Best Presentation* of a Session at the 1988, 1990, 1993, 1994, 1995 American Control Conferences.

*Best Paper Special Award*, from the Society of Instrumentation and Control Engineers (SICE, Japan) for the paper "Method for Robust Stabilization of a Digital Control System," with S. Hara and H. Fujioka, in the special issue of the 30th Anniversary of the Society.

*Invitation* to participate in the program "Control Theory and Its Applications," of the Institute for Mathematics and Its Applications, University of Minnesota, Fall 1992.

*Invitation* to write a chapter in the ACADEMIC Press Theme Volumes on "Digital Design and Control System Techniques and Applications," C.T. Leondes, Ed.

*Nomination* as "Black Engineer of the Year" to the Council of Engineering Deans of the Historically Black Colleges and Universities (one of 300).

Aerospace Engineering Department *Teaching Award*, Feb. 1994

Certificate of Appreciation, Society of Minority Engineering Students, College of Engineering, 1994.

Certificate of Recognition, Association of Black Professionals and Administrators (ABPA), 1994.

Elected *Fellow of IEEE*, December 1996, for contributions to the development of sampled-data hold function control of dynamic systems

Silver Shaft Award, for excellence in undergraduate teaching, by \_\_\_\_\_, April 2002

### **Patents**

Low-Cost Satellite Imaging System Using Wavefront Reconstruction, Patent disclosure filed by the University of Michigan, with David Hyland, and the students of Aero 483/583, Winter 2001.

Target Reduction and Balancing Using System Norms, Patent disclosure filed by Ford Motor Company, with Haitam Mahmoud, Galip Ulsoy, and Jerry Brusher.

Feedforward Control of Data Rate in Wireless Networks, Patent Disclosure filed with the University of Michigan, with S.M Meerkov, W. Stark and C.Y. Tang

### **Consulting Experience**

I have acted as consultant for Automated Analysis Corporation, Ann Arbor; Navistar International, Fort Wayne; Sierra Lobo, Inc, Sandusky, Ohio; and DaimlerChrysler, Dayton Ohio.

### **Professional Service**

Past Associate Editor, *Mathematical Modeling of Systems: Methods, Tools and Applications in Engineering and Related Sciences*.

Associate Editor, *MATHEMATICAL PROBLEMS IN ENGINEERING: Problems, Theories, and Applications*.

Reviewer for: NSF, *IEEE Trans. Auto. Contr.*, *IEEE Trans. Circ. Syst.*, *SIAM J. Contr. Opt.*, *Automatica*, *J. Guid. Contr. Dyn.*, *J. Dyn. Syst. Meas. Contr.*, *Int. J. Contr.*, *Conf. Dec. Contr.*, *Amer. Contr. Conf.*, ASME Winter Annual Meeting, IEEE Int. Conf. Robot. Auto.

Reviewer on several NSF evaluation panels.

Session Chair and Co-Chair at several CDC and ACC conferences.

Member, Program Committee of the 1992 ACC.

Publicity Chair, and Program Committee Member, 1994 ACC, Baltimore

Vice-Chair, Invited Sessions, 1995 ACC

Vice-Chair, Publications, 2000 ACC

Member, University of Michigan College of Engineering Executive Committee, July 2003-