# Konstantinos S. Tsakalis

Professor

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## Educational Record

1. *Ph.D. in Electrical Engineering*, University of Southern California, August 1988.
2. *M.S. in Electrical Engineering*, University of Southern California, December 1985.
3. *M.S. in Chemical Engineering*, University of Southern California, May 1984.
4. *Professional Diploma in Chemical Engineering*, National Technical University of Athens, Greece, June 1983.

## Work Experience

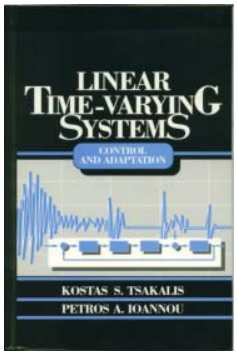
- **Faculty Appointments**
  1. *Professor*, August 2003 – Present, E.E. Department, Arizona State University.
  2. *Associate Professor*, August 1994 – August 2003, E.E. Department, Arizona State University.
  3. *Assistant Professor*, August 1988 – August 1994, E.E. Department, Arizona State University.
- **Related Academic Experience**
  1. ECEE Associate Director for Infrastructure 2010-present, ECEE, Arizona State University
  2. Visiting Professor, Aug.-Dec. 2004, Department of Physics, University of Athens, Greece.
  3. Visiting Professor, May-Jun. 1998, Department of Physics, University of Athens, Greece.
  4. Research Assistant, 1984-1988, Department of Electrical Engineering, University of Southern California.
  5. Teaching Assistant, 1982-1984, Department of Chemical Engineering, University of Southern California.
- **Consulting Experience**
  1. *InControl Engineering*, 2008-Present: Optimization, PID Tuning, System Identification, Monitoring and Control Applications in the Semiconductor Industry
  2. *Honeywell*, 1998-Present: Optimization, PID Tuning, System Identification and Control of Paper Machines, Identification and Control Applications in the Petrochemical Industry, Coal Gassification, Polymerization reactors, Nonlinear MPC.
  3. *Applied Materials/SEMY Engineering/Brooks Automation*, 1998-2008: System Identification and Control in Semiconductor Manufacturing, Diffusion/CVD Furnace Temperature Control, Embedded Control Systems, Run-to-Run Control.

4. *EPRI*, 2002-2004: Modeling and Control of Pulverizers.
5. Sept.-Jan. 1997: Semy Engineering (sabbatical leave)
6. Jan.-Apr. 1997: Honeywell HTC, Phoenix (sabbatical leave).

## Areas of Teaching and Research

- *General Topics:*
  Control theory. Robust and adaptive control, time-varying systems (SISO and MIMO), performance guarantees and limitations. Estimation theory and system identification. Nonlinear systems. Optimization theory and optimal control. Implementation of embedded control systems using MATLAB, rapid prototyping.
- *Integrated system identification and controller design:*
  Dynamic uncertainty estimation and multivariable controller design (loop-shaping). PID tuning. Controller performance monitoring. Controller implementation issues. Applications to semiconductor manufacturing and chemical process control. Applications to power systems.
- *Biomedical applications:*
  Prediction and control of epileptic seizures. Theoretical development and application to data from human and animal models. Feedback control experimentation in animal models.
- *Manufacturing process control:*
  Run-to-run control, process optimization, scheduling of operations.
- *Education:*
  Internet-based analysis and design tools (J-DSP-C), Embedded control systems using MATLAB and LABVIEW. Virtual lab experiments using PC104 and FPGA boards for process emulation and control, with realistic process I/O.

## Publications




**Summary:** 1 Book, 12 Book Chapters, 54 Journal Papers, 10 Patents, 117 Conference papers. Over 1172 Journal-only citations (source: ISI Web of Science, Mar. 2015).

### I. Books

1. K. S. Tsakalis and P. A. Ioannou, *Linear Time-Varying Systems: Control and Adaptation*, Prentice-Hall, Englewood Cliffs, New Jersey, 1993.

### II. Book Chapters

1. Ioannis Vlachos, Aaron Faith, Steven Marsh, Jamie White-James, Kostantinos Tsakalis, David M. Treiman and Leon D. Iasemidis, "Brain Network Characteristics in Status Epilepticus," TM Rassias et al eds *Optimization in Science and Engineering*, Springer New York 543-552, 08 May 2014,
2. Jennie Si; Lei Yang; Chao Lu; Kostas S. Tsakalis; Armando A. Rodriguez, "Toward Design of Nonlinear ADP Learning Controllers with Performance Assurance Reinforcement Learning and Approximate

Dynamic Programming for Feedback Control." *IEEE Press Series on Computational Intelligence,* IEEE Press, 182-202, 2013.

3. K. Tsakalis and S. Dash, "Identification for PID Control," in PID Control in the Third Millennium, A. Visioli, R. Villanova Eds., Chapter 10, 283-317, Springer-Verlag London Limited, 2012

4. S. Sabesan, L.D. Iasemidis, K. Tsakalis, D.M. Treiman, J. Sirven, "Use of dynamical measures in prediction and control of focal and generalized epilepsy," in: Epilepsy: The Intersection of Neurosciences, Biology, Mathematics, Engineering and Physics, Eds. H. Zaveri, I. Osorio, H. Zaveri, M.G. Frei, S. Arthurs, CRC Press, Boca Raton, FL, Ch.20, pp. 307-320, 2011.

5. S. Sabesan, K.Tsakalis, A. Spanias, L.D. Iasemidis, "A Robust Estimation of Information Flow in Coupled Nonlinear Systems," in Computational Neuroscience, Eds. W. Chaovalitwongse, P.M. Pardalos, P. Xanthopoulos, Springer Series on Optimization and its Applications, Springer Science, New York, v.38, 271-284, 2010.

6. A. Faith, S. Sabesan, N. Wang, D. Treiman, J. Sirven, K. Tsakalis, L.D. Iasemidis, "Dynamical analysis of the EEG and treatment of human status epilepticus by anti-epileptic drugs," in Computational Neuroscience, Eds. W. Chaovalitwongse, P.M. Pardalos, P. Xanthopoulos, Springer Series on Optimization and its Applications, Springer Science, New York, v.38, 305-316, 2010.

7. L.D. Iasemidis, S. Sabesan, N. Chakravarthy, A. Prasad, K.Tsakalis, "Brain Dynamics and Modeling in Epilepsy: Prediction and Control Studies," in Complex Dynamics of Physiological Systems: From Heart to Brain, Eds. S.K. Dana, P.K. Roy, J. Kurths, Springer Series on Complexity, Springer Verlag, The Netherlands, 185-214, 2009.

8. L.D. Iasemidis, S. Sabesan, L. Good, N. Chakravarthy, D. Treiman, J. Sirven, K.Tsakalis, "A new look into epilepsy as a dynamical disorder: seizure prediction, resetting and control," Encyclopedia of Basic Epilepsy Research, Ed. Philip Schwartzkroin, Elsevier, vol. 3, pp. 1295-1302, 2009.

9. H. Al-Nashash, S. Sabesan, B. Krishnan, J. George, K. Tsakalis, L. Iasemidis, S. Tong, "Single-Channel EEG Analysis," in *Quantitative EEG Analysis Methods and Clinical Applications,* Eds. Shanbao Tong and Nitish Thakor, Artech House, Norwood, MA, pp. 73-90, 2009.

10. S. Sabesan, L. Good, N. Chakravarthy, K. Tsakalis, P.M. Pardalos, L.D. Iasemidis, "Global optimization and spatial synchronization changes prior to epileptic seizures," Eds. C.J.S. Alves, P.M. Pardalos, L.N. Vicente, Optimization in Medicine, Coimbra, Portugal, July 20-22, 2005, Springer Series in Optimization and its Applications, Springer, pp. 103-125, 2008.

11. S. Sabesan, K. Narayanan, A. Prasad, L.D. Iasemidis, A. Spanias and K. Tsakalis, "Information flow in coupled nonlinear systems: Application to the epileptic human brain," In: *Data Mining in Biomedicine*, Series: Springer Optimization and Its Applications , Vol. 7, 483-504, P. Pardalos, V. Boginski, A. Vazacopoulos (Eds.), 2007.

12. P.A. Ioannou and K.S. Tsakalis, "Robust Discrete-Time Adaptive Control," in *Adaptive and Learning Systems: Theory and Applications*, Plenum Press, edited by K. S. Narendra, 1986.

**III. Journal Papers**

1. R. Joshi, K. Tsakalis, J.W. MacArthur, S. Dash, "Account for Uncertainty with Robust Control Design: Part 1," *Chemical Engineering Progress,* 31-38, Nov. 2014.

2. R. Joshi, K. Tsakalis, J.W. MacArthur, S. Dash, "Account for Uncertainty with Robust Control Design: Part 2," *Chemical Engineering Progress,* 46-50, Dec. 2014.

3. Steenis, J. ; Tsakalis, K. ; Ayyanar, R., "An Approach to Bumpless Control for LPV Modeled Inverters in a Microgrid" *IEEE Transactions on Power Electronics*, V.29, 11, 6214-6223, 2014.

4. Tsakalis, K. S., Dash, S. "Approximate H-inf loop shaping in PID parameter adaptation." *International Journal of Adaptive Control and Signal Processing,* 27(1-2), 136-152, 2013.

5. Tsakalis K, Vlassopoulos N, Lentaris G, Reisis D., "A Control-Theoretic Approach for Efficient Design of Filters in DAC and Digital Audio Amplifiers," *Circuits, Systems and Signal Processing*, 30, 2, 421-438, Apr. 2011.

6. L.B.Good, S. Sabesan, S.T. Marsh, K. Tsakalis, D.M. Treiman, L.D. Iasemidis, "Nonlinear Dynamics of Seizure Prediction in a Rodent Model of Epilepsy," Nonlinear Dynamics, Psychology and Life Sciences, v.14, 5, 411-434, 2010.

7. L. Yang, J. Si, K.S. Tsakalis, A.A. Rodriguez, A. A., "Direct Heuristic Dynamic Programming for Nonlinear Tracking Control With Filtered Tracking Error," IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics, Volume 39, Issue 6, 1617 - 1622, Dec. 2009.

8. L. Yang, J. Si, K.S. Tsakalis, A.A. Rodriguez, A. A., "Performance Evaluation of Direct Heuristic Dynamic Programming Using Control-Theoretic Measures," J. Intell. Robot Syst., 55, 177 - 201, 2009.

9. Iasemidis LD, Tsakalis KS, Osorio I, et al., "Special Issue: Neuromodulation and Control of Epileptic Seizures, INTRODUCTION," *Int. J. of Neural Systems,* V.19, 3 Pages: V-VII, June 2009.

10. S. Sabesan, L.B. Good, K.S. Tsakalis, A. Spanias, D.M. Treiman, L.D. Iasemidis, "Information Flow and Application to Epileptogenic Focus Localization From Intracranial EEG," IEEE Transactions on Neural Systems and Rehabilitation Engineering, Volume 17, Issue 3, 244 - 253, June 2009.

11. L.B. Good, S. Sabesan, S.T. Marsh, K. Tsakalis, D.M. Treiman, L.D. Iasemidis, "Control of Synchronization of Brain Dynamics Leads to Control of Epileptic Seizures in Rodents," International Journal of Neural Systems (IJNS) Volume: 19, Issue: 3, pp. 173-196, 2009.

12. N. Chakravarthy, K. Tsakalis, S. Sabesan, L. Iasemidis, Homeostasis of Brain Dynamics in Epilepsy: A Feedback Control Systems Perspective of Seizures, Annals of Biomedical Engineering Volume 37, 3, 565-585, 2009.

13. N. Chakravarthy, S. Sabesan, K. Tsakalis, L. Iasemidis, "Controlling epileptic seizures in a neural mass model," *Journal of Combinatorial Optimization,* Springer Sci. and Bus. Media, 17: 98-116, Jan. 2009.

14. S. Sabesan, N. Chakravarthy, K. Tsakalis, L.D. Iasemidis, "Measuring resetting of brain dynamics at epileptic seizures: Application of global optimization and spatial synchronization techniques", *Journal of Combinatorial Optimization,* Springer Sci. and Bus. Media, 17: 74-97, Jan. 2009.

15. Venkatraman Atti, Andreas Spanias, Kostas Tsakalis, Constantinos Panayiotou, Leon Iasemidis and Visar Berisha "Gradient Projection-Based Channel Equalization Under Sustained Fading," *Signal Processing,* Vol. 88, 2, 236-246, February 2008.

16. Kostas Tsakalis and Sachi Dash "Multivariable controller performance monitoring using robust stability conditions," *Journal of Process Control,* Vol. 17, 9, 702-714, October 2007.

17. Niranjan Chakravarthy, S. Sabesan, L.D. Iasemidis, K. Tsakalis, "Controlling synchronization in a neuron-level population model," *Intern. Journal of Neural Systems*, Vol. 17, No. 2, 123 - 138, April 2007.

18. A. Spanias, K. Huang, A. Natarajan, R. Ferzli, H. Kwon, V. Atti, V. Berisha, L. Iasemides, H. Krishnamoorthi, P. Spanias, S. Misra, M. Banavar, K. Tsakalis, S. Haag, "Interfacing Java-DSP with a TI DSK for use in a Signal Processing Class," ASEE Computers in Education Journal, Vol. XVII, No. 3, pp. 27-35, Issue: July-Sep. 2007.

19. Kostas Tsakalis and Leon Iasemidis,"Control Aspects of a Theoretical Model for Epileptic Seizures," *International Journal of Bifurcation and Chaos.* Special Issue "Complexity: A Unifying Direction in Science," Vol. 16,7, 2006.

20. K. Tsakalis, Niranjan Chakravarthy, S. Sabesan, L.D. Iasemidis, P.M. Pardalos, "A feedback control systems view of epileptic seizures," *Cybernetics and Systems Analysis*, vol. 42, pp.483-495, 2006.

21. Niranjan Chakravarthy, Kostas Tsakalis, Leon D. Iasemidis, Andreas Spanias, "A Multi-dimensional Scheme for Controlling Unstable Periodic Orbits in Chaotic Systems," *Physics Letters A,* Nonlinear Science, 349, 116-127, 2006.

22. Awadhesh Prasad, Leon D Iasemidis, Shivkumar Sabesan and Kostas Tsakalis "Dynamical hysteresis and spatial synchronization in coupled non-identical chaotic oscillators," *PRAMANA - Journal of Physics*, Vol.64, No.4, 513-523, Apr. 2005.

23. L.D. Iasemidis, D-S Shiau, P.M. Pardalos, W.Chaovalitwongse, K. Narayanan, A. Prasad, K. Tsakalis, P. Carney and J.C. Sackellares, "Long-term prospective on-line real-time seizure prediction", *Clinical Neurophysiology*, Elsevier, 116, 532-544, Jan. 2005.

24. L.D. Iasemidis, K. Tsakalis, J.C. Sackellares, and P.M. Pardalos, "Comment on "Inability of Lyapunov Exponents to Predict Epileptic Seizures," *Physical Review Letters* 94, 019801, week ending 14 Jan. 2005.

25. H. Wu, K.S. Tsakalis, G.T. Heydt, "Evaluation of Time Delay Effects to Wide-area Power System Stabilizer Design," *IEEE Transactions on Power Systems*, V.19, 4, 1935–1941, Nov. 2004.

26. K.S. Tsakalis and J.C. Palais, "Improving a School's *U.S. News and World Report* Ranking," *Journal of Engineering Education*, V.93, 3, 259-263, July 2004.

27. B. Veeramani, K. Narayanan, A. Prasad, L.D. Iasemidis, A.S. Spanias, K. Tsakalis, "Measuring the direction and the strength of coupling in nonlinear Systems-a modeling approach in the State space," *Signal Processing Letters,* IEEE, V. 11, 7, 617-620, July 2004.

28. T. Ogasawara, K. Tsakalis, C. Hornberg, "Improving Low-Temperature Control on a Vertical Furnace Using Model-Based Temperature Control," *Semiconductor Manufacturing,* Semi, V. 5, 2, 161-166, Feb. 2004.

29. N. Chakravarthy, A. Spanias, L. D. Iasemidis, and K. Tsakalis, "Autoregressive Modeling And Feature Analysis Of DNA Sequences," *EURASIP* Jasp 2004:1 (2004) 13-28.

30. L.D. Iasemidis, D.-S. Shiau, W. Chaovalitwongse, J.C. Sackellares, P.M. Pardalos, J.C. Principe, P.R. Carney, A. Prasad, B. Veeramani, and K. Tsakalis, "Adaptive Epileptic Seizure Prediction System," *IEEE Transactions on Biomedical Engineering*, 50, 5, 616-627, May 2003.

31. K. Tsakalis, S. Dash, A. Green and W. MacArthur, "Loop-shaping controller design from input-output data: application to a paper machine simulator," *IEEE Transactions on Control Systems Technology,* Vol. 10, No. 1, 127-136, Jan. 2002.

32. E. Grassi, K. Tsakalis, S. Dash, S.V. Gaikwad, W. MacArthur and G. Stein, "Integrated Identification and PID Controller Tuning by Frequency Loop-Shaping," *IEEE Trans. Contr. Systems Technology*, 9, 2, 285-294, March 2001.

33. Suttipan Limanond and K.S. Tsakalis, "Adaptive and non-adaptive 'pole-placement' control of multivariable linear time-varying plants," *Int. J. Control*, 74, 5, 507-523, 2001.

34. Suttipan Limanond and K.S. Tsakalis, "Model Reference Adaptive and Nonadaptive Control of Linear Time-Varying Plants," *IEEE Trans. Automat. Contr.*, 45, 7, 1290-1300, July 2000.

35. E. Grassi and K. Tsakalis, "PID Controller Tuning by Frequency Loop-Shaping: Application to Diffusion Furnace Temperature Control," *IEEE Trans. Contr. Systems Technology*, 8, 5, 842-847, Sept. 2000.

36. M. Beaudoin, E. Grassi, S.R. Johnson, K. Ramaswamy, K. Tsakalis, T.L. Alford and Y.H. Zhang, "Real-time composition control of InAlAs grown on InP using spectroscopic ellipsometry," *J. Vac. Sci. Technol. B* 18(3), pp. 1435-1438 , May/Jun 2000.

37. Elena Grassi, Shane R. Johnson, Mario Beaudoin, and Kostas S. Tsakalis, "Temperature-composition determination based on modeling of optical constants of III-V compound semiconductors measured by spectroscopic ellipsometry," *J. Vac. Sci. Technol. B* 17(3), pp. 1223-1226 , May/Jun 1999.

38. S.R. Johnson, E. Grassi, M. Beaudoin, M.D. Boonzaayer, K.S. Tsakalis, and Y.H. Zhang, "Closed-loop control of composition and temperature during the growth of InGaAs lattice matched to InP," *J. Vac. Sci. Technol. B* 17(3), pp. 1237-1240 , May/Jun 1999.

39. S.R. Johnson, E. Grassi, M. Beaudoin, M.D. Boonzaayer, K.S. Tsakalis, Y.H. Zhang, "Feedback control of substrate temperature during the growth of near-lattice-matched InGaAs on InP using diffuse reflection spectroscopy," *Journal of Crystal Growth*, 201/202, pp. 40-44, 1999.

40. E. Grassi, S.R. Johnson, M. Beaudoin, K.S. Tsakalis, "Modeling of optical constants of InGaAs and InAlAs measured by spectroscopic ellipsometry," *Journal of Crystal Growth*, 201/202, pp. 1081-1084, 1999.

41. M. Yelverton, K. Tsakalis and K. Stoddard, "Factory-wide run-to-run process control," *Solid State Technology*, pp. 45-52, Dec. 1999.

42. S. Limanond, J. Si and K.S. Tsakalis, "Monitoring and Control of Semiconductor Manufacturing Processes," *IEEE Control Systems,* V. 18, 6, 46-58, Dec. 1998.

43. K.S. Tsakalis, "Bursting Scenaria in Adaptive Algorithms: Performance Limitations and Some Remedies," *Kybernetika*, 33, 1, 17–40, 1997.

44. K.S. Tsakalis, "Performance Limitations of Adaptive Parameter Estimation and System Identification Algorithms in the Absence of Excitation," *Automatica*, 32, 4, 549–560, 1996.

45. K.S. Tsakalis, M. Deisher and A. Spanias, "System Identification Based on Bounded Error Constraints," *IEEE Trans. Signal Proc.*, 43, 12, 3071–3075, Dec. 1995.

46. K.S. Tsakalis and Suttipan Limanond, "Asymptotic Performance Guarantees in Adaptive Control," *Int. J. of Adaptive Control and Signal Processing*, Vol. 8, 173–199, 1994.

47. K.S. Tsakalis, "Adaptive Control of Linear Time-Varying Plants: The Case of "Jump" Parameter Variations," *Int. Journal of Control* Vol. 56, No. 6, pp. 1299–1345, 1992.

48. K.S. Tsakalis, "Robustness of Model Reference Adaptive Controllers: An Input-Output Approach," *IEEE Trans. Automat. Contr.*, Vol. 37, No. 5, pp. 556–565, May 1992.

49. K.S. Tsakalis and P.A. Ioannou, "A New Indirect Adaptive Control Scheme for Time-Varying Plants," *IEEE Trans. Automat. Contr.*, AC-35, No. 6, pp. 697–705, June 1990.

    • Also in *"Advances in Adaptive Control.* Edited by K.S. Narendra, R. Ortega and P. Dorato, IEEE Press, Piscataway NJ, 1991." (Selected reprints providing a review of the then state-of-the-art in adaptive control.)

50. K.S. Tsakalis and P.A. Ioannou, "Adaptive Control of Linear Time-Varying Plants: A New Model Reference Controller Structure," *IEEE Trans. Automat. Contr.*, AC-34, pp. 1038–1046, Oct. 1989.

51. K.S. Tsakalis and P.A. Ioannou, "Adaptive Control of Time-Varying Plants: Simple Examples," *Int. J. of Adaptive Control and Signal Processing*, Vol. 2, pp. 291–309, Dec. 1988.

52. K.S. Tsakalis and P.A. Ioannou, "Adaptive Control of Linear Time-Varying Plants," *Automatica*, Vol. 26, No. 4, pp. 459–468, July 1987.

53. P.A. Ioannou and K.S. Tsakalis, "A Robust Direct Adaptive Controller," *IEEE Trans. Automat. Contr.*, AC-31, No. 11, pp. 1033 – 1043, Nov. 1986.

54. K.S. Tsakalis, T.T. Tsotsis and G.J. Stiegel, "Deactivation Phenomena by Site Poisoning and Pore Blockage: The Effect of Catalyst Size, Pore Size and Pore Size Distribution," *Jour. of Catalysis*, 88, 188–202, July 1984.

**IV. Patents**

1. Jassemidis, Leonidas, D; Tsakalis, Konstantinos, S; "Pacemaker for treating physiological system dysfunction," *U.S. Pat. No. 8,197,395*, June 12, 2012.

2. S.V. Gaikwad, S.K. Dash, K.S. Tsakalis, "On-demand auto-tuner for a plant control system," *U.S. Patent No. 7,920,929*, April 5, 2011.

3. S.K. Dash, S.V. Gaikwad, K.S. Tsakalis, "Apparatus and method for controller performance monitoring in a process control system," *U.S. Patent No. 7,787,978*, August 31, 2010.

4. S.V. Gaikwad, S.K. Dash, K.S. Tsakalis, and G. Stein, "Auto-tuning controller using loop-shaping," *U.S. Patent No. 7,024,253*, April 4, 2006.

5. K.D. Stoddard, B.D. Schulze, and K. Tsakalis, "Run-to-run controller for use in microelectronic fabrication," *U.S. Patent No. 6,587,744*, July 1, 2003.

6. K. Stoddard, P.R. McHugh, and K. Tsakalis, "Temperature Control System for a Thermal Reactor," *U.S. Patent No. 6,441,350*, August 27, 2002.

7. K. Stoddard, P.R. McHugh, and K. Tsakalis, "Temperature Control System for a Thermal Reactor," *U.S. Patent No. 6,222,164 B1*, April 24, 2001.

8. K. Stoddard, P.R. McHugh, and K. Tsakalis, "Temperature Control System for a Thermal Reactor," *U.S. Patent No. 6,211,495 B1*, April 3, 2001.

9. K. Stoddard, P.R. McHugh, and K. Tsakalis, "Temperature Control System for a Thermal Reactor," *U.S. Patent No. 6,207,937 B1*, March 27, 2001.

10. K. Stoddard, J.B. Hugues, and K. Tsakalis, "Model Based Temperature Controller for Semiconductor Thermal Processors," *U.S. Patent No. 5,895,596*, April 20, 1999.

**V. Technical Reports**

1. C. Taft, P. Wolf, K. Tsakalis, "Advanced Pulverizer Control: Design and Testbed Implementation," Final Report, EPRI, Palo Alto, CA, March 2004, 1004423.

**VI. Conference Papers (Refereed and Invited)**

1. Venkataraman, V. ; Vlachos, I. ; Faith, A. ; Krishnan, B. ; Tsakalis, K. ; Treiman, D. ; Iasemidis, L., "Brain dynamics based automated epileptic seizure detection," *Proc. 2014 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC),* 946 - 949, 2014.

2. Georgis, G. ; Reisis, D. ; Skordilakis, P. ; Tsakalis, K. ; Bin Shafique, A. ; Chatzikonstantis, G. ; Lentaris, G., "Neuronal connectivity assessment for epileptic seizure prevention: Parallelizing the generalized partial directed coherence on many-core platforms," *Proc. 2014 International Conference on Embedded Computer Systems: Architectures, Modeling, and Simulation (SAMOS XIV)*, 359 - 366, 2014.

3. Steenis, J. ; Breazeale, L. ; Tsakalis, K. ; Ayyanar, R., "$H-\infty$ and gain scheduled $H-\infty$ control for islanded microgrids," *Proc. Energy Conversion Congress and Exposition (ECCE)*, 4603 - 4608, 2013.

4. K. Tsakalis, "Real-time considerations in the localization and control of epileptic seizures," Presentation and Abstract in *1st Hellenic Forum for Science, Technology, and Innovation, EKEFE Dimokritos*, 17-19 Jul 2013, Athens, Greece (I).

5. K. Tsakalis, "Parameter Estimation for Identification in H-infinity," Presentation and Abstract In *Control and Adaptation: A 30-year journey*, Workshop, 24-Jun-2013, Larnaca, Cyprus.

6. Steenis, J.; Tsakalis, K.; Ayyanar, R. "Robust control of an islanded microgrid," *Proc. IECON 2012 - 38th Annual Conference on IEEE Industrial Electronics Society*, 2447 - 2451, 2012.

7. Ashfaque B.Shafique and Konstantinos Tsakalis, "Discrete-Time PID Controller Tuning Using Frequency Loop-Shaping," Proc. IFAC Conference on Advances in PID Control (PID'12), (6 pages), Brescia March 27-30, 2012.

8. L. Iasemidis, I. Vlachos, B. Krishnan, R. Sidique, E. Tobin, V. Venkataraman, A. Faith, S. Prasanna, A. Shafique, K. Tsakalis, S. Marsh, D. Treiman, S. Sabesan, S. Maschino, "Reduction of seizure frequency by responsive just-in-time VNS in an animal model of chronic epilepsy," 66th American Epilepsy Society Annual meeting, San Diego, CA, December, 2012.

9. I. Vlachos, B. Krishnan, R. Sidique, E. Tobin, V. Venkataraman, A. Faith, S. Prasanna, A. Shafique, K. Tsakalis, L. Iasemidis, S. Marsh, D. Treiman, S. Sabesan, S. Maschino, "Long-term effect of VNS on seizure burden in an animal model of chronic epilepsy," 66th American Epilepsy Society Annual meeting, San Diego, CA, December, 2012.

10. L.D. Iasemidis, S. Sabesan, A. Faith, B. Krishnan, K. Tsakalis, D. Treiman, "The importance of stimulus location in DBS for control of epileptic seizures," 65th American Epilepsy Society Annual meeting, Baltimore, MD, December, 2011 (Conference Abstract and Poster Presentation).

11. Balu Krishnan, Shashank Prasanna, Oliver Letham, Aaron Faith, Ioannis Vlachos, Rashaad Sidique, Edward Tobin, Konstantinos Tsakalis, Steven Marsh, David Treiman, Leonidas Iasemidis, "Seizure Prediction and Control" 5th International Workshop on Seizure Prediction (IWSP), Dresden, Sep. 19-23, 2011 (Poster Presentation, I).

12. Konstantinos Tsakalis, Jayaraman J Thiagarajan, Tolga Duman, Martin Reisslein, G. Tong Zhou, XiaoLi Ma and Photini Spanias, "Modules and Laboratories for a Pathways Course in Signals and Systems," Session T2G: Transforming Engineering Laboratories through Information Technologies, (2 pages) 2011 Frontiers in Education Conference, Rapid City, South Dakota, October 12 - 15, 2011.

13. Balu Krishnan, Shashank Prasanna, Oliver Letham, Aaron Faith, Ioannis Vlachos, Rashaad Sidique, Edward Tobin, Konstantinos Tsakalis, Steven Marsh, David Treiman, Leonidas Iasemidis, "Seizure Prediction and Control" 5th International Workshop on Seizure Prediction (IWSP), Dresden, Sep. 19-23, 2011 (Poster Presentation, I).

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## Sponsored Research Projects

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2. C. Torres (PI), B. Rittmann, K. Tsakalis, "Wastewater Treatment Using Microbial Fuel Cells with Peroxide Production," DOD-SERDP, 9/28/2012 - 9/27/2015, $1,901,602

3. L. Iasemidis(PI), K. Tsakalis, D. Treiman, "Characterization of Novel Vagus Nerve Stimulation (VNS) Parameters Efficacy, Based on Desynchronization of Brain Dynamics, in Open and Closed-Loop Configurations: A Study in an Animal Model of Chronic Epilepsy," Cyberonics Inc., 05/27/10-10/31/11, $560,000.

4. L. Iasemidis(PI), K. Tsakalis, D. Treiman, "Vagus Nerve Stimulation: A Bioengineering Approach to Assess its Effect on Resetting the Epileptic Brain Dynamics," NIH R21 NS061310-01A2, Apr.09-Apr.11, $414,714.

5. L. Iasemidis(PI), J. Sirven, K. Tsakalis, "Optimizing Multidimensional Time Series Classification: Spatio-Temporal Data Mining in Epileptic Brain Dynamics," Science Foundation of Arizona CAA 0281-08; Jul.08-Jul.09, $267,000

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7. K. Tsakalis (PI), L. Iasemidis, and D. Treiman, "Cyber Systems: Closed-Loop Control of Brain Dynamics in Epilepsy ," National Science Foundation, ECS-0601740, June 1, 2006 - May 31, 2010 $240,000.

8. K. Tsakalis (PI), J. Si, and A. Rodriguez, "Embedded Control Systems II," Consortium for Embedded Systems, 11/1/2005-12/31/2006 (5/15/2007), $43,013.

9. L. Iasemidis (PI), K. Tsakalis, and D. Treiman, "Seizure Control by Closed Loop Feedback in a Rat Model of Chronic Temporal Lobe Epilepsy," Epilepsy Foundation, July 1, 2005 - June 30, 2006 $100,000.

10. A. Rodriguez, (PI), K. Tsakalis, D. Allee, J. Si, "Rapid Prototyping for Embedded System Applications Via High Level Development Tools," NSF, DUE 0443133, 5/1/2005-4/30/2007, $75,000

11. J. Si (PI), A. Rodriguez, K. Tsakalis, "A Control-Theoretic Approach to Learning and Approximate Dynamic Programming (ADP) with Applications to High Performance Racing," NSF, 5/1/04-4/30/07, $190,000.

12. A. Rodriguez (PI), J. Si, K. Tsakalis, "A Flexible Embedded System Architecture and Methodology for Integrated Real-Time Helth Monitoring, Modeling, Control Law Design, and Implementation," Consortium for Embedded and Internetworking Technologies, 8/25/04-8/24/05, $75,137.

13. K. Tsakalis (PI), J. Si, and A. Rodriguez, "Embedded Control Systems: Undergraduate Course Development," Consortium for Embedded and Internetworking Technologies, 1/1/04-5/15/05, $56,588.

14. A. Spanias (PI), T. Duman, L. Karam, A. Papandreou, and K. Tsakalis, "On Line Undergraduate Laboratories in Signal and Image Processing, Communications, and Controls," NSF DUE 0089075, 1/1/01 – 12/31/03, $425,000.

15. K.S. Tsakalis, "Advanced Process Control in Semiconductor Manufacturing," SEMY Engineering/Brooks Automation, 8/15/95 – 8/14/03, $188,027.

    — Equipment Donation, 1999-2001, $325,000.

16. A.A. Rodriguez (PI), W. Higgins, J. Si, K.S. Tsakalis, and F. Hoppensteadt, "MOSART: A Model Undergraduate Multidisciplinary Controls Laboratory," NSF DUE 9851422, 8/15/98 – 7/31/01, $95,442.

17. K.S. Tsakalis, "Advanced Process Control In Paper Production," Honeywell Technology Center, Phoenix, 9/1/98–8/31/99, $24,999.

18. K. Tsakalis (PI) and A. Rodriguez, "Integrated Multi-Sensor Control for MBE Control of III-V Nanostructures." ARPA, 7/7/95–9/28/98, $150,041. (ASU, Sensor group; part of a multi-univeristy/industry proposal)

19. K.S. Tsakalis (PI) and D.E. Rivera, "A Control-Theoretic Approach to Scheduling of Semiconductor Fabrication Processes," INTEL Research Council, 1/1/95–12/31/97, $111,000.

20. D.E. Rivera (PI) and K.S. Tsakalis, "Benefits of Advanced Process Control Methods in Semiconductor Manufacturing," Motorola SPS, 2/1/96–5/31/96, $15,732.

21. P.E. Crouch (PI), T.S. Cale, G.B. Raupp, D.K. Ferry, M.N. Kozicki, K.S. Tsakalis and C. Ringhofer, "Mathematical Modeling for Simulation and Control of Semiconductor Processing," DoD-URI (ARPA), 10/1/92–5/31/96, $693,000.

22. W.T. Higgins (PI), P.E. Crouch, A.A. Rodriguez and K.S. Tsakalis, "Undergraduate Control Systems Design Laboratory," NSF, USE-9251934, 5/1/92–10/31/94, $50,232.

23. K.S. Tsakalis, "Parameter Estimation In Adaptive Control," NSF-RIA, ECS-9111346 9/1/91–2/28/94, $59,956.

24. D. Rivera (PI) and K.S. Tsakalis, "Robust Adaptive Process Control of Chemical Processes with Implementation on the TDC 3000," (within the "ASU-Honeywell Control Systems Engineering Program" by D. Shunk and D. Rivera) Honeywell Industrial Automation and Controls Division; 3/26/93–3/25/94 and 4/16/92–8/7/92, $12,284 (Summer support).

**Internal Grants**

1. L. Iasemidis (PI), J. Si, A. Spanias and K. Tsakalis, "Dynamical Modeling and Control of Epileptic Seizures," Fulton School of Engineering, Seed Funding Award, $48,000, June 2003-June 2004.

2. K.S. Tsakalis, ASU-RIA on the project "Design of Estimators for Adaptive Controllers with Robust Performance," 9/5/89–9/4/90, $20,000 (funds from VPR and EE Dept).

3. K.S. Tsakalis, "Design of Robust Adaptive Controllers," DWR-B594, ASU-FGIA, 1/1/89–12/31/89, $3,285.

4. K.S. Tsakalis, "Performance Issues in Adaptive Control," DWR-B677, ASU-FGIA, 1/1/90–12/31/90, $3,000.

## Graduated Students

**Ph.D.**

- C. Zhan (August 2008): System Identification for Robust Control.
- J. Dankert (May 2008, with J. Si): Approaches to Asynchronous Control of Motor Cortical Neural Prosthetics.
- S. Sabesan (May 2008, with L. Iasemidis): Spatiotemporal Brain Dynamics In Epilepsy: Application To Seizure Prediction And Focus Localization.
- N. Chakravarthy (May 2007, with L. Iasemidis): Modeling and Controlling Epileptic Seizures - A Feedback Control Systems Perspective
- J.J. Flores-Godoy (Dec. 2002): Nonlinear identification for diffusion/Chemical Vapor Deposition furnaces.
- E. Grassi (Dec. 1999): Proportional-integral-derivative controller tuning by frequency loop-shaping.
- G. Nair (Apr. 1998, with A. Spanias): Fast adaptive algorithms using eigenspace projections.
- L. Song (May 1997): Optimal control problems in chemical vapor deposition.
- A. Abdalla (May 1996): Control of linear time-varying systems.

- S. Limanond (Aug. 1994): Adaptive and non-adaptive control of multivariable linear time-varying plants.

**M.S.**

- Ashfaque Md Shafique (Nov. 2011): Discrete-time PID Controller Tuning Using Frequency Loop Shaping.
- Rajendra Bhat (Dec. 2009): Controller Switching and Optimal State Selection.
- Harikrishnan Raghunathan (Dec. 2007): Observer techniques for nonlinear systems.
- Manikandan Ponnuswamy (Dec. 2005, with L. Iasemidis): Dynamical Analysis Of Epileptic Seizures Using Synchronization-Based Measures.
- C. Hornberg (Dec. 2004): Wafer Optimized Profile Temperature Control of a Semiconductor Diffusion Furnace
- T. Thrasyvoulou (Aug. 2003, with A. Spanias): Adaptive beamforming using a complex bounding ellipsoid algorithm with gradient projections.
- Aris Papadopoulos (Dec. 2002): Swinging up the inverted pendulum by energy adaptive proportional-integral-derivative control.
- Kaushik Bhatt (Dec. 2002): Performance Monitoring of Controllers.
- J. Kristof (May 2000, with T. Cale): Optimal programmed rate chemical vapor deposition of tungsten.
- J. Frigo (Dec. 1996): An analog neural network control method proposed for use in spacecraft systems.
- C. Alexander (May 1995): System modeling and control of an inverted pendulum: an input-output approach.
- K. Stoddard (Sep. 1994, with P. Crouch and M. Kozicki): Application of feedforward and adaptive feedback control to semiconductor device processing.
- C.C. Kok (May 93): Application of neural network in the control of an oxidation process.
- Y.N. Liao (May 1992): Constrained parameter estimation in model reference adaptive control.
- S. Limanond (Dec. 1991): Decentralized adaptive linear quadratic control for time-varying systems.

## Courses Taught

| Undergraduate | Graduate |
|---|---|
| EEE301(201) Electrical Networks I | EEE550 Transform Theory |
| EEE303 Signals and Systems | EEE582 Linear System Theory |
| EEE322 System Design Using Microprocessors | EEE586 Nonlinear Control Systems |
| EEE480 Feedback Systems | EEE587 Optimal Control Systems |
| EEE482 Introduction to State-Space Methods | EEE686 Adaptive Control |
| Special Topics | |
| EEE498/481 Computer Controlled Systems | EEE598 Special Topics in Nonlinear Systems Analysis |
| | EEE598 Applied Optimization |
| | |

**New Courses and Course Material Developed**

*1. EEE 498 (481), Computer Controlled Systems*: The raw computational power of modern microprocessors in conjunction with software that can produce real-time executables from high-level code, allow the implementation of sophisticated control algorithms with unprecedented low requirements on hardware cost, development time, and user expertise. The usefulness of these developments is not limited to the academic environment but extends to the industry as well. Reflecting these recent trends, relevant course topics include sensors, actuators, real-time operation, software and hardware platforms, and basic communication and control algorithms. These topics are presented with a focus on embedded control systems and rapid prototyping and deployment.

*2. EEE 686, Adaptive Control*: Adaptive Systems have been introduced in control in an effort to cope with large plant uncertainty, arising when simple mathematical models are used to describe complex physical processes. The use of such models is justified by the availability of general controller design procedures for linear systems. However, due to the complexity of the physical processes, the parameters of the simplified linear models may be partially unknown and/or time-varying. Adaptive controllers have been developed to counteract such forms of parametric uncertainty and improve the closed loop performance of linear control laws. The course addresses the fundamental theoretical principles and practical issues arising in the analysis and design of adaptive controllers. Particular emphasis is placed on the demonstration of the theoretical concepts with simple numerical examples.

*3. EEE 598, Applied Optimization*: The objective of the course is to serve as an introduction to applied optimization methods. Its intent is to provide familiarity with the essential theoretical concepts and algorithms arising in a wide spectrum of problems of both unconstrained and constrained optimization. Examples and numerical implementation of basic algorithms play a central role in illustrating the ideas discussed during the course. In addition to the standard generic examples, the application of optimization techniques in parameter estimation and system identification is discussed in more detail.

*4. EEE 598, Special Topics in Nonlinear Systems Analysis*: The course covers advanced aspects of nonlinear systems theory with emphasis on concepts and analytical tools pertaining to system identification. The topics of study include input-output methods and the small gain theorem, differential geometric methods, reachability and observability, identifiability, and basic identification techniques for linear and nonlinear systems. The main objective is to provide a fairly rigorous theoretical treatment of the subject, while assignments include detailed computer simulation studies of selected applications.

*5. EEE 482, Introduction to state-space methods, Course Material*: Introduced a controller design project in EEE 482 based on actual data from semiconductor furnaces. This project illustrates the various phases of industrial-grade controller design from data collection to controller implementation. It required considerable development of material (notes, simulator, codes etc.) distributed through the web.

**Other Educational Activities**

- Led two CEINT/CES grants for the development of an embedded control systems course (EEE481, Computer Controlled Systems). This included the development of instruction materials and the acquisition, setup and maintenance of significant hardware for the lab. Over 20 PC104 embedded controller boards with A/D-D/A and 3 FPGA DSP Development Kits (ALTERA Stratix Edition) were purchased with grant funding and are being used both for the course needs and for undergraduate and graduate experimentation.

- Worked under an Undergraduate Education NSF grant to develop novel Java-based laboratory experiments for on-line undergraduate and continuing education in signal and image processing, communications and controls (J-DSP, J-DSP-C).

- Other sponsored educational projects include several NSF grants for laboratory infrastructure upgrades.

- Supervised 8 graduate-level independent study courses in Control Systems.

- Supervised over 20 undergraduate Senior Design Projects (EEE 490). Most notable projects are:

- The walking Hydrapod, an exceptional idea for a simple walking robot, conceived and implemented by the students.
- Design of a self-initializing adaptive PID controller for the inverted pendulum experiment, to achieve practically global stabilization at the upright position for arbitrary pendulum weight and length.
- Design and implementation of industrial-grade, multivariable controllers for the ASU cleanroom furnaces. (Cleanroom experience in addition to data-collection, controller design and implementation in a production furnace.)
- Award winning project for the construction of an autonomous robot and its embedded controller that communicates with a host computer via wireless communication and describes its environment, e.g., mapping a room or a maze. (Spring 2004 Electrical Engineering Senior Design Prize.)

## Service

- Associate Editor, IMA Journal on Mathematical Control and Information (2013-)
- Student Programs Chair for 2017 American Control Conference
- Member of the IFAC Technical Committee "Adaptive and Learning Systems" (2015-2017)
- Member of the Program Committee for the "Industrial Controls" track of ETFA 2015 Conference.
- IPC member of the IFAC Conference on Advances in PID Control, Brescia, Mar. 2012
- Associate Editor for the joint 48th IEEE Conference on Decision and Control and 28th Chinese Control Conference, Dec. 2009.
- Keynote Talk, Chaotic Modeling and Simulation Int. Conf. CHAOS 2009.
- Session Chair, Data Mining in Biomedicine Conf. DMINBIO'09, AIT, Greece, May 2009.
- Associate Editor for MED 2009, 17th Mediterranean Conference on Control and Automation, June 2009.
- International Program Committee for the IASTED conferences "Modelling, Identification and Control (MIC)" 2006–2015.