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Department of Chemical Engineering
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EDUCATION

- PhD **Georgia Institute of Technology**, Chemical Engineering, November 2004
Thesis: Modeling, analysis and control of nonlinear switching systems
Advisor: Prof. Jay H. Lee
- Purdue University**, Chemical Engineering, August 1999 – July 2000
Same as above
- BS **UDCT, University of Mumbai, India**, Chemical Engineering, July 1999

AWARDS AND HONORS

- Outstanding graduate student award, Georgia Institute of Technology, April 2003
- Andrews Research Fellow, Purdue University, August 1999 – 2000
- R. A. Rajadhyaksha Innovative Project Award for the best undergraduate research assistantship project for the year 1997, University of Mumbai

PROFESSIONAL EXPERIENCE

INDIAN INSTITUTE OF TECHNOLOGY – CHENNAI

Assistant Professor in Chemical Engineering (June 2007 – current)

- Modeling, Design and Control of Fuel Processing Fuel Cell Systems

UNIVERSITY OF DELAWARE

Post Doctoral Research Fellow to Prof. Dionisios G. Vlachos (January 2005 – April 2007)

- Multi-scale modeling of reacting flows in integrated micro-reactors for power generation
- Super-structure-based optimization of reactor network to determine the optimal temperature and reactant feed profiles in fuel processing applications
- Microkinetic model development for ammonia decomposition and oxidative dehydrogenation

GEORGIA INSTITUTE OF TECHNOLOGY

Graduate Research Assistant to Prof. Jay H. Lee (August 1999 – December 2004)

- Developed models for hydrogen generation in a microreactor with periodic flow reversal to compare unidirectional and reverse-flow operations of the reactor. Investigated the effect of radiation and the choice of reaction kinetics for this reactor.
- Performed time scale analysis to determine optimal operation of the reverse-flow microreactor.
- Considered optimal switching between multiple steady states in a bioreactor using a novel *simulation-based Dynamic Programming* (sim-DP) algorithm. Sim-DP uses a neural network or a local averager to express the *desirability* of a system state.
- Considered the comparison of the choice of learning algorithm, function approximator and exploration of state space in applying sim-DP.
- Applied two-step model identification method to obtain separate deterministic and stochastic models for control of Kappa number in a pulp digester.
- Developed an iterative design of input test signals for model identification of a linear multi-variable process.

WEYERHAEUSER CO., WA

Summer Intern, (May 2001 – August 2001)

Developed Labview® modules to access historic plant data and use it for data pre-treating, model identification and control of a pulp and paper plant

LUBRIZOL INDIA LTD., THANE, INDIA

Summer Intern, (May 1998 – July 1998)

Assisted in re-design of distillation and CO₂ absorption systems for increased plant capacity

UDCT, UNIVERSITY OF MUMBAI

Undergraduate Research Assistant to Prof. A. B. Pandit (May 1997 – August 1997)

Topic: Photocatalytic degradation of distillery waste in solar illuminated TiO₂ slurry

This work won the R. A. Rajadhyaksha award for best undergraduate research (1997)

BOOK CHAPTERS

- 1 Kaisare N. S., G. D. Stefanidis and D.G. Vlachos (2008), "Transport Phenomena in Microscale Reacting Flow," in *Handbook of Microprocess Engineering, Part A: Fundamentals, Operations and Catalysts*, A. Renken and Y. Wang (Eds.), Wiley-VCH, Berlin, in press

PUBLICATIONS

- 2 Kaisare N. S., J. M. Lee and J. H. Lee (2003), "Simulation based strategy for nonlinear optimal control: Application to a microbial cell reactor," *Int. J. Robust and Nonlinear Control*, 13: 347–363.
- 3 Kaisare N. S., J. H. Lee and A. G. Fedorov (2005), "Hydrogen generation in a reverse-flow microreactor: 1. Model formulation and scaling," *A.I.Ch.E. Journal*, 51: 2254–2264.
- 4 Kaisare N. S., J. H. Lee and A. G. Fedorov (2005), "Hydrogen generation in a reverse-flow microreactor: 2. Simulation and Analysis," *A.I.Ch.E. Journal*, 51: 2265–2272.
- 5 Peroni C. V., N. S. Kaisare and J. H. Lee (2005), "Optimal control of a fed batch bioreactor using simulation-based approximate Dynamic Programming," *IEEE Trans. Control Systems Technology*, 13: 786–790.
- 6 Kaisare N. S., J. H. Lee and A. G. Fedorov (2005), "Operability analysis and design of a reverse-flow microreactor for hydrogen generation," *Ind. Eng. Chem. Res.*, 44:8323–8333.
- 7 Lee J. M., N. S. Kaisare and J. H. Lee (2006), "Choice of approximator and design of penalty function for an approximate dynamic programming based control approach," *J. Process Control*, 16: 135–156.
- 8 Kaisare N. S. and J. H. Lee (2005), "L-Optimal design of periodic test input signals for multivariable impulse response models," *Automatica*, submitted.
- 9 Vlachos D. G., A. B. Mhadeshwar and N. S. Kaisare (2006), "Hierarchical multiscale model-based design of experiments, catalysts, and reactors for fuel processing," *Comput. Chem. Eng.*, 30: 1712–1724
- 10 Kaisare N. S. and D. G. Vlachos (2007), "Optimal reactor dimensions for homogeneous combustion in small channels," *Catal. Today*, 120: 96–106.
- 11 Kaisare N. S. and D. G. Vlachos (2007), "Extending the region of stable homogeneous micro-combustion through forced unsteady operation," *Proc. Combust. Inst.*, 31: 3293–3300
- 12 Kaisare N. S., S. R. Deshmukh and D. G. Vlachos (2008), "Stability and Performance of Catalytic Microreactors: Simulations of Propane Catalytic Combustion on Pt," *Chem. Eng. Sci.*, 63: 1098–1116.
- 13 Stefanidis G. D., N. S. Kaisare and D. G. Vlachos (2008), "Modeling ignition in catalytic microreactors," *Chem. Eng. Technol.*, 31: 1170–1175.

- 14 Kaisare N. S., G. D. Stefanidis and D. G. Vlachos (2009), "Comparison of Ignition Strategies for Catalytic Microburners," *Proc. Combust. Inst.*, 32: 3027–3034.
- 15 Stefanidis G. D., N. S. Kaisare, M. Maestri, and D. G. Vlachos (2009), "Methane steam reforming at microscale: Operation strategies for variable power output at millisecond contact times," *AIChE Journal*, 55: 180–191
- 16 Kaisare N. S., G. D. Stefanidis and D. G. Vlachos (2009), "Millisecond production of hydrogen from alternative, high hydrogen density fuels in a co-current multifunctional microreactor," *Ind. Eng. Chem. Res.*, in press

PROCEEDINGS AND PRESENTATIONS

- 1 Vikram, S. and N. S. Kaisare, "Simulation of Ignition Characteristics of Various Fuels in a Catalytic Microreactor," European Combustion Meeting, April 2009, accepted.
- 2 Kaisare N. S., G. D. Stefanidis and D. G. Vlachos, "Comparison of Ignition Strategies for Catalytic Microdevices," *32nd Symposium on Combustion*, Canada, August 2008.
- 3 Kaisare N. S., G. D. Stefanidis and D. G. Vlachos, "Ignition Strategies for Catalytic Microdevices," In *IMRET - 10: 10th Int. Conf. on Microreactor Tech.*, April 2008, New Orleans, LA.
- 4 Stefanidis G. D., N. S. Kaisare, M. Maestri, E. Tronconi and D. G. Vlachos, "Design Principles of Multifunctional Microdevices for Hydrogen Production Via Short Contact Time Steam Reforming," In *IMRET - 10: 10th Int. Conf. on Microreactor Tech.*, April 2008, New Orleans, LA.
- 5 Prasad V., A. Karim, N. S. Kaisare, D. Hansgen and D. G. Vlachos, "A unified modeling framework for design of multi-site catalysts: Application to NH₃ decomposition for H₂ production," 20th North American Meeting of Catalysis Society, June 2007, Houston, TX.
- 6 Kaisare N. S. and D. G. Vlachos, "Optimization of heat recuperating reactor strategies for autothermal hydrogen generation," 20th North American Meeting of Catalysis Society, June 2007, Houston, TX.
- 7 Kaisare N. S., S. R. Deshmukh and D. G. Vlachos, "A numerical investigation of stability and performance of catalytic combustion in microreactors," AIChE annual meeting, Nov. 2006, San Francisco, CA.
- 8 Federici J. A., N. S. Kaisare, E. Wetzel and D. G. Vlachos, "Enhancing microburner stability for portable power generation through heat recuperation," AIChE annual meeting, Nov. 2006, San Francisco, CA.
- 9 Kaisare N. S. and D. G. Vlachos (2006), "Extending the region of stable homogeneous micro-combustion through forced unsteady operation," 31st International Symposium on Combustion, Heidelberg, Germany.
- 10 Vlachos D. G., A. B. Mhadeshwar and N. S. Kaisare (2006), "Hierarchical multiscale model-based design of experiments, catalysts, and reactors for fuel processing," Chemical Process Control 7, Alberta, Canada.
- 11 Kaisare N. S., S. R. Deshmukh and D. G. Vlachos (2005), "On the stability of micro-scale heat sources", AIChE annual meeting, Nov. 2005, Cincinnati, OH
- 12 Deshmukh S. R., N. S. Kaisare and D. G. Vlachos (2005), "Hierarchical modeling of integrated microdevices for hydrogen production", AIChE annual meeting, Nov. 2005, Cincinnati, OH
- 13 Kaisare N. S., J. M. Lee and J. H. Lee (2005), "Empirical results on convergence and exploration in simulation-based Approximate Dynamic Programming," In proceedings of IFAC World Congress, July 2005, Prague, Czech Republic.
- 14 Kaisare N. S., A. G. Fedorov and J. H. Lee (2004), "Hydrogen generation in a microreactor with periodic flow reversal: Simulation and Analysis," AIChE. annual meeting, Nov. 2004.
- 15 Peroni C. V., J. H. Lee and N. S. Kaisare (2003), "Optimization of a fed-batch bioreactor using simulation-based approach," In proceedings of ADCHEM 2003, Jan 2004, Hong Kong

- 16 Lee J. H. and N. S. Kaisare (2003), "Control relevant L-optimal design of periodic test input signals for iterative open-loop identification of multivariable FIR systems," In proceedings of 13th symposium on System Identification, SYSID-2003, August 2003, Rotterdam
- 17 Kaisare N. S., J. M. Lee and J. H. Lee (2002), "Simulation based optimization for nonlinear optimal control," In proceedings of IFAC World Congress, July 2002, Barcelona, Spain
- 18 Kaisare N. S., R. Amirthalingam and J. H. Lee (2001), "Inferential control of a two-vessel kamyr digester," In proceedings of Pulp Digester Monitoring and Control Workshop, June 2001, Annapolis, MD
- 19 Kaisare N. S., J. M. Lee and J. H. Lee (2002), "Comparison of value iteration, policy iteration and temporal difference in dynamic programming based optimal control," AIChE. annual meeting, Nov. 2002, Indianapolis
- 20 Lee J. M., N. S. Kaisare, T. Thosukhowong and J. H. Lee (2002), "Detection of abnormalities at their onset," AIChE. annual meeting, Nov. 2002, Indianapolis
- 21 Kaisare N. S., A. A. Namjoshi, J. H. Lee and D. Ramkrishna (2000), "Nonlinear Model Predictive Control of hybridoma cell reactor using cybernetic modeling," AIChE. annual meeting, Nov. 2000, Los Angeles
- 22 Bedekar A. S. and N. S. Kaisare (1998), "Reactive distillation for production of MTBE: A review," *Cheminar*, March 1998, Manipal Institute of Technology, Manipal, India.
Won the first prize in the undergraduate review paper category

COMPUTER SKILLS

Languages: Fortran, Basic, C, Pascal, Lisp, Perl (CGI)

Software packages: Matlab, ISIM, MS-Office, LaTeX, Lotus Suite, etc.

Others: Advanced knowledge of HTML, CSS, Javascripts. Websites designed include submission and review portal for the 6th IFAC Symposium on Dynamics and Control of Process Systems (DYCOPS-6), Cheju, S. Korea.

OTHER ACTIVITIES

- Reviewer for Ind. Eng. Chem. Res., IEEE Trans. C.S.T., AIChE J., and other journals
- Volunteer for Child Relief and You (CRY) Inc. Managed the website and web-based sales of greeting cards and CRY products throughout the US
- Maintained website and helped Prof. Jay Lee put together technical sessions for DYCOPS-6, an international control conference