

RUDIYANTO (RUDI) GUNAWAN

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 Department of Chemical Engineering
 University of California Santa Barbara
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EDUCATION

2003 **Ph.D. Chemical Engineering**, University of Illinois at Urbana-Champaign
 Thesis title: *Modeling and Control of Transient Enhanced Diffusion of Boron in Silicon*
 Thesis advisers: Richard D. Braatz and Edmund G. Seebauer (GPA = 3.91)

2000 **M.S. Chemical Engineering**, University of Illinois at Urbana-Champaign
 Thesis title: *Dimensionality Reduction and Robustness Analysis of Large Scale Systems*
 Thesis adviser: Richard D. Braatz

1998 **B.S. Chemical Engineering & Mathematics**, University of Wisconsin at Madison
 Graduated with Highest Distinction (GPA = 3.96)
 Dean's Honor List 1994 – 1998
 Hotaling Scholarship 1997 (given to the top 5% of undergraduates in College of Engineering)

DOCTORAL and POSTDOCTORAL RESEARCH

Postdoctoral Fellow, *University of California Santa Barbara* 9/2003 – present

- Performed research in the area of systems biology with interests in optimal experiment design, systems identification, dynamical sensitivity analysis, and discrete stochastic systems; with applications in circadian rhythm, frog egg cell cycle, genetic toggle switch, enzymatic futile cycle, and apoptosis.
- Developed iterative experiment design procedure and optimal measurement selection for iterative model development of biological systems, applied to the identification of caspase-activated apoptosis model.
- Developed dynamical sensitivity analysis for discrete stochastic systems, applied to gene regulatory models for circadian rhythm and genetic toggle switch.
- Developing dynamical phase sensitivity analysis for biological oscillatory systems, applied to circadian rhythm phase resetting.
- Developing methodologies for the design of bistable genetic switch using bifurcation analysis and explicit stochastic approach, applied to enzymatic futile cycle and synthetic gene switch.
- Actively involved in the development of sensitivity analysis tools BioSens, as part of open-source computational biology tools Bio-SPICE funded by DARPA BioComp program.
- Actively involved in the collaborative work (UCSB, UC Berkeley, UCLA, Walter Reed, Thomas Jefferson U, Indiana U, KGI, NYU, SRI) of modeling staphylococcal enterotoxin B-apoptosis pathway in kidney cells as part of Bio-SPICE (DARPA BioCOMP Project).

Research Assistant, *University of Illinois at Urbana-Champaign* 8/1998 – 8/2003

- Performed research in the area of control systems with interests in robust control, optimal control, model reduction, experiment design, model identification, and hyperbolic systems;

with applications in time delay systems, batch crystallization, microelectronics processing, and particulate systems.

- Developed model reduction and robustness analysis techniques for large-scale multivariable systems with uncertain time delays.
- Developed and applied optimal experiment design to determine kinetic parameters for nucleation and growth in batch crystallization of potassium dihydrogen-phosphate.
- Developed and analyzed a reaction-diffusion model for transient enhanced diffusion (TED) of boron in Si during the manufacture of ultrashallow p-n junctions for advanced CMOS.
- Employed maximum likelihood and Bayesian parameter estimation to identify the TED kinetic parameters from literature and experimental data provided by International Sematech.
- Designed the optimal annealing procedure that achieves the optimal p-n junction thickness.
- Developed a worst case analysis for the manufacture of ultrashallow p-n junctions to quantify the effects of model parameter uncertainties and control implementation errors.
- Developed high resolution methods for simulating population balance equations from batch crystallization modeling with size-independent and -dependent growth rates and aggregation.
- Developed a software package Particle Solver based on the finite volume method for simulating general particulate system dynamics described by population balance equations.

GRANTS AND FELLOWSHIPS

UIUC Graduate Student Travel Grant 2002

PROFESSIONAL ACTIVITIES

Member, American Institute of Chemical Engineers

Member, IEEE

Reviewer, Automatica (nominated as Automatica outstanding reviewer for 2004)

BIBLIOGRAPHY

Patent:

1. "Methods for Controlling Dopant Concentration and Activation in Semiconductor Structures" with E. G. Seebauer, R. D. Braatz and M. Y. L. Jung, patent application 8/2004.

Book Chapter:

1. R. Gunawan, K. Gadkar, and F. J. Doyle III. Methods to Identify Cellular Architecture and Dynamics from Experimental Data. In J. Stelling (Ed.), System Modeling in Cellular Biology: From Concepts to Nuts and Bolts, MIT Press, 2005. in press

Journal Articles:

1. R. Gunawan and F. J. Doyle III. Isochron-based Phase Sensitivity Analysis of Oscillatory Systems, 2005. in preparation
2. K. Gadkar, R. Gunawan, and F. J. Doyle III. Iterative approach to model identification of biological networks, *BMC Bioinformatics*, 2005. in press
3. R. D. Braatz, R. C. Alkire, E. G. Seebauer, E. Rusli, R. Gunawan, T. O. Drews, X. Li, and Y. He. Perspectives on the dynamics and control of multiscale systems, *J. Process Control*, 2005. in press
4. R. Gunawan, Y. Cao, L. Petzold, and F. J. Doyle III. Sensitivity analysis of discrete stochastic system. *Biophys. J.*, 88:2530-2540, 2005.

5. M. Y. L. Jung, R. Gunawan, R. D. Braatz, and E. G. Seebauer. Pair diffusion and kick-out: Contributions to diffusion of boron in silicon. *AIChE J.*, 50:3248-3256, 2004.
6. R. Gunawan, I. Fusman, and R. D. Braatz. High resolution algorithms for multidimensional population balance equations. *AIChE J.*, 50:2738-2749, 2004.
7. M. Y. L. Jung, R. Gunawan, R. D. Braatz, and E. G. Seebauer. Effect of near-surface band bending on dopant profiles in ion-implanted silicon. *J. Appl. Phys.*, 95:1134-1140, 2004.
8. M. Fujiwara, J. C. Pirkle Jr., T. Togkalidou, D. L. Ma, R. Gunawan, and R. D. Braatz. A holistic approach to materials process design. *J. Materials Edu.*, 24:65-70, 2004.
9. M. Y. L. Jung, R. Gunawan, R. D. Braatz, and E. G. Seebauer. A simplified picture for transient enhanced diffusion of boron in silicon. *J. Electrochem. Soc.*, 151:G1-G7, 2004.
10. R. Gunawan, M. Y. L. Jung, R. D. Braatz, and E. G. Seebauer. Optimal control of rapid thermal annealing in a semiconductor process. *J. Process Control*, 14:423-430, 2004.
11. K. Dev, M. Y. L. Jung, R. Gunawan, R. D. Braatz, and E. G. Seebauer. Mechanism for coupling between properties of interfaces and bulk semiconductors. *Phys. Rev. B.*, 68:195311-195316, 2003.
12. M. Y. L. Jung, R. Gunawan, R. D. Braatz, and E. G. Seebauer. Ramp-rate effects on transient enhanced diffusion and dopant activation. *J. Electrochem. Soc.*, 150:G838-G842, 2003.
13. R. Gunawan, M. Y. L. Jung, R. D. Braatz, and E. G. Seebauer. Parameter sensitivity analysis applied to modeling transient enhanced diffusion and activation of boron in silicon. *J. Electrochem. Soc.*, 150:G758-G765, 2003.
14. R. Gunawan, M. Y. L. Jung, R. D. Braatz, and E. G. Seebauer. Maximum *a posteriori* estimation of transient enhanced diffusion kinetics. *AIChE J.*, 49:2114-2123, 2003.
15. R. Gunawan, D. L. Ma, M. Fujiwara, and R. D. Braatz. Identification of kinetic parameters in a multidimensional crystallization process. *Int. J. Modern Phys. B*, 16:367-374, 2002.
16. R. Gunawan, E. L. Russell, and R. D. Braatz. Comparison of theoretical and computational characteristics of dimensionality reduction methods for large scale uncertain systems. *J. Process Control*, 11:543-552, 2001.

Peer-reviewed Conference Proceedings:

1. R. Gunawan, M. Y. L. Jung, E. G. Seebauer, and R. D. Braatz. Optimal control of transient enhanced diffusion. In *Proc. of the IFAC Symp. on Advanced Control of Chemical Processes*, pp. 603-608, Hong Kong, China, 2003.
2. R. Gunawan, M. Y. L. Jung, R. D. Braatz and E. G. Seebauer. Systems Analysis Applied to Modeling Dopant Activation and TED in Rapid Thermal Annealing. In *Proc. of the 10th IEEE Intl. Conf. on Advanced Thermal Processing of Semiconductors*, pp. 107-110, 2002.
3. R. Gunawan, E. L. Russell, and R. D. Braatz. Robustness analysis of multivariable systems with time delays. In *Proc. of European Control Conf.*, pp. 1882-1887, Porto, Portugal, 2001.
4. M. Y. L. Jung, R. Gunawan, R. D. Braatz, and E. G. Seebauer. New physics for modeling transient enhanced diffusion in RTP. In *Rapid Thermal & Other Short-Time Processing Technologies*, vol. 2000-9, pp. 15-20, 2000. The Electrochemical Society.

INVITED LECTURES:

1. Department of Chemical Engineering. Auburn University, Auburn, AL, Feb 2003.
2. Department of Chemical Engineering. Lehigh University, Lehigh, PA, Apr 2003.