RUDIYANTO (RUDI) GUNAWAN

Institute for Chemical and Bioengineering
HCI F 101, Wolfgang-Pauli-Strasse 10
ETH Zurich
CH-8093 Zurich
rudi.gunawan@chem.ethz.ch

EDUCATION:

2003 Ph.D. Chemical Engineering, University of Illinois Urbana-Champaign
2000 M.S. Chemical Engineering, University of Illinois Urbana-Champaign
1998 B.S. Chemical Engineering & Mathematics, University of Wisconsin – Madison

ACADEMIC APPOINTMENTS:

2011-	Assistant Professor, ETH Zürich
2006-2011	Assistant Professor, National University of Singapore
2008-2010	Singapore-MIT Alliance Fellow, Chemical & Pharmaceutical Engineering
2007-2008	Singapore-MIT Alliance Visiting Professor
2003-2006	Postdoctoral Fellow, University of California Santa Barbara
1998-2003	Research Assistant, University of Illinois Urbana-Champaign
2000	Lecturer, University of Illinois Urbana-Champaign
1999-2000	Teaching Assistant, University of Illinois Urbana-Champaign

HONORS AND AWARDS

- University of Wisconsin Dean's List (1994-1998)
- University of Wisconsin Hotaling Scholarship (1997)
- UIUC Graduate Student Travel Grant (2002)
- Best Paper of 2006, Computers and Chemical Engineering (2008)
- Best Theory/Methodology Paper 2005-2008, Journal of Process Control, Elsevier (2008)

PROFESSIONAL ACTIVITIES

International Programming Committee

- *International Conference on Molecular Systems Biology (ICMSB)*, UP Diliman, Philippines, February 2008.
- *3rd International Conference on Bioinformatics and Systems Biology (BSB)*, Chongqing, China, July 2010

National Programming Committee

- *5th International Symposium on Design, Operation and Control of Chemical Processes*, Singapore, July 2010
- *14th Asia Pacific Confederation of Chemical Engineering Congress (APCChE)*, Singapore, February 2012
- *International Symposium on Advanced Control of Chemical Processes (ADCHEM)*, Singapore, July 2012

Reviewer for Journals

- *Automatica, Bioinformatics, IET Systems Biology, BMC Systems Biology, Metabolic Engineering, Industrial and Engineering Chemistry Research, Journal of Biotechnology, Chemical Engineering Research and Design, Crystal Design and Growth.*

Professional Societies

- Member, American Institute of Chemical Engineers (AIChE)
- Member, IEEE
- Member, Tau Beta Pi

RESEARCH INTERESTS

- Areas: systems biology, process modeling and control, robustness analysis, sensitivity analysis, model identification, population balance equation, chemical master equation.
- Applications: mitochondrial free radical theory of aging, mitochondrial fusion and fission, metabolic engineering, circadian rhythms, programmed cell death, crystallization, rapid thermal annealing in microelectronics processing.

PUBLICATIONS

Patent:

1. "Methods for controlling dopant concentration and activation in semiconductor structures" with E. G. Seebauer, R. D. Braatz and M. Y. L. Jung, US Patent 7,846,822.

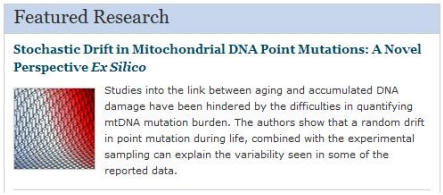
Book Chapters:

1. H. Mirsky, J. Stelling, R. Gunawan, N. Bagheri, S. R. Taylor, E. Kwei, J. E. Shoemaker, and F. J. Doyle III. Automatic Control in Systems Biology. In S. Y. Nof (Ed.), Handbook of Automation, Springer-Verlag, 2009.
2. S. Hildebrandt, N. Bagheri, R. Gunawan, H. Mirsky, J. Shoemaker, S. Taylor, L. R. Petzold and F. J. Doyle III. Systems Analysis in Biological Networks. In E. T. Liu, G. P. Noland, and D. A. Lauffenburger (Eds.), Systems Biomedicine: Concepts and Prespectives, Academic Press, 2009.
3. R. Gunawan, K. Gadkar, and F. J. Doyle III. Methods to identify cellular architecture and dynamics from experimental data. In Z. Szallasi, V. Periwal, and J. Stelling (Eds.), System Modeling in Cellular Biology, MIT Press, 2006.

Journal Articles:

1. Z. Y. Tam, Y. H. Cai and R. Gunawan. Elucidating cytochrome C release from mitochondria: insights from an *in silico* three-dimensional model. *Biophys. J.*, 99:3155-3163, 2010. (cover article)

2. S. K. Poovathingal and R. Gunawan. Global parameter estimation of stochastic biochemical systems. *BMC Bioinformatics*, 11:414, 2010.
3. J. Gruber, S. K. Poovathingal, N. L. Fang, R. Gunawan and B. Halliwell. *Caenorhabditis elegans* lifespan studies: the challenge of maintaining synchronous cohorts, *Rejuvenation Research*, 13:347-349, 2010.
4. S. Srinath and R. Gunawan. Parameter identifiability of power-law biochemical system models. *J. Biotechnol*, 2010. 149:132-140, 2010.
5. S. K. Poovathingal, J. Gruber, B. Halliwell, and R. Gunawan. Stochastic drift in mitochondrial DNA point mutations: a novel perspective ex silico. *PLoS Comput Biol*, 5:e1000572, 2009. (featured research Nov 2009, listed in Faculty 1000 Biology)


Featured Research

Stochastic Drift in Mitochondrial DNA Point Mutations: A Novel Perspective *Ex Silico*

Studies into the link between aging and accumulated DNA damage have been hindered by the difficulties in quantifying mtDNA mutation burden. The authors show that a random drift in point mutation during life, combined with the experimental sampling can explain the variability seen in some of the reported data.

6. T. M. Perumal, Y. Wu, and R. Gunawan. Dynamical analysis of cellular networks based on the Green's function matrix. *J. theor Biol*, 261:248-259, 2009.
7. R. Gunawan, I. Fusman, and R. D. Braatz. Parallel high-resolution finite volume simulation of particulate processes. *AIChE J.*, 54:1449-1458, 2008.
8. S. Taylor, R. Gunawan, L. R. Petzold, and F. J. Doyle III. Sensitivity measures for oscillating systems: application to mammalian circadian gene network. *IEEE Trans. Automatic Control*, 153:177-188, 2008.
9. R. Gunawan and F. J. Doyle III. Phase sensitivity analysis of circadian rhythm entrainment. *J. Biol. Rhythms*., 22:180-194, 2007.
10. R. Gunawan and F. J. Doyle III. Isochron-based phase response analysis of circadian rhythms. *Biophys. J*., 91:2131-2141, 2006.
11. F. J. Doyle III, R. Gunawan, N. Bagheri, H. Mirsky, and T.-L. To. Circadian rhythm: A natural, robust, multi-scale control system. *Comp. & Chem. Eng.*, 30:1700-1711, 2006.
12. R. D. Braatz, R. C. Alkire, E. G. Seebauer, T. O. Drews, E. Rusli, M. Karulkar, F. Xue, Y. Qin, M. Y. L. Jung and R. Gunawan. A multiscale systems approach to microelectronics processes. *Comp. & Chem. Eng.*, 30:1643-1656, 2006.

13. 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*, 16:193-204, 2006.
14. K. Gadkar, R. Gunawan, and F. J. Doyle III. Iterative approach to model identification of biological networks. *BMC Bioinformatics*, 6:155-174, 2005.
15. R. Gunawan, Y. Cao, L. Petzold, and F. J. Doyle III. Sensitivity analysis of discrete stochastic system. *Biophys. J.*, 88:2530-2540, 2005.
16. 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.
17. R. Gunawan, I. Fusman, and R. D. Braatz. High resolution algorithms for multidimensional population balance equations. *AIChE J.*, 50:2738-2749, 2004.
18. 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.
19. 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.
20. R. Gunawan, M. Y. L. Jung, E. G. Seebauer, and R. D. Braatz. Optimal control of rapid thermal annealing in a semiconductor process. *J. Process Control*, 14:423-430, 2004.
21. 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.
22. 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.
23. 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.
24. R. Gunawan, M. Y. L. Jung, E. G. Seebauer, and R. D. Braatz. Maximum *a posteriori* estimation of transient enhanced diffusion kinetics. *AIChE J.*, 49:2114-2123, 2003.
25. 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.
26. 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, 2002.
27. 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. T.M. Perumal, Y. Wu, and R. Gunawan. Robustness analysis of cellular systems for *in silico* drug discovery. In *Proc. of the 17th IFAC World Congress*, Seoul, South Korea, July 2008.
2. F. J. Doyle III, R. Gunawan, N. Bagheri, H. Mirsky, and T.-L. To. Circadian rhythm: A natural, robust, multi-scale control system. In *Proc. of Chem. Process Control*, Alberta, Canada, January 2006.

3. R. Gunawan and F. J. Doyle III. Phase sensitivity analysis of a circadian gene network. In *Proc. of the 44th IEEE Conf. on Decision & Control and European Control Conf.*, December 2005.
4. 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, 2003.
5. 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.
6. 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, 2001.
7. 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.

PRESENTATIONS

Invited Lectures:

1. Department of Chemical Engineering, Auburn University, USA, 2003.
2. Department of Chemical Engineering, Lehigh University, USA, 2003.
3. Division of Chemical and Biomolecular Engineering, Nanyang Technological University, Singapore, 2005.
4. Department of Chemical and Biomolecular Engineering, National University of Singapore, Singapore, 2006.
5. Department of Chemical Engineering, Purdue University, USA, 2006.
6. Department of Chemical Engineering, University of Florida-Gainesville, USA, 2006.
7. Department of Chemical Engineering, Massachusetts Institute of Technology, USA, 2006.
8. Graduate Program in Bioinformatics, Boston University, USA, 2006.
9. Department of Chemical Engineering, University of Texas at Austin, USA, 2006.
10. Institute for Chemical and Bioengineering, ETH Zürich, 2010.

Conference Presentations:

1. R. Gunawan, D. L. Ma, M. Fujiwara, and R. D. Braatz. Identification of kinetic parameters in a multidimensional crystallization process. *Int. Conf. on Materials for Advanced Technologies*, Symposium D: Crystallization and Interfacial Processes, Singapore, July 2001. (poster)
2. R. Gunawan, M. Y. L. Jung, E. G. Seebauer, and R. D. Braatz. Maximum *a posteriori* estimation of transient enhanced diffusion kinetics. *AIChE Annual Meeting*, Indianapolis, IN, November 2002.
3. R. Gunawan, M. Y. L. Jung, E. G. Seebauer, and R. D. Braatz. Optimal control of transient enhanced diffusion. *AIChE Annual Meeting*, Indianapolis, IN, November 2002.

4. R. Gunawan, M. Y. L. Jung, R. D. Braatz, and E. G. Seebauer. Systems analysis applied to modeling transient enhanced diffusion. *AIChE Annual Meeting*, Indianapolis, IN, November 2002.
5. R. Gunawan, I. Fusman, and R. D. Braatz. High resolution algorithms for multidimensional population balance equations with nucleation and size-dependent growth. In *AIChE Annual Meeting*, San Francisco, CA, November 2003.
6. R. Gunawan, Y. Cao, L. Petzold, and F. J. Doyle III. Stochastic sensitivity analysis of cellular processes. In *Intl. Conf. of Molecular Systems Biology*, Lake Tahoe, CA, August 2004.
7. R. Gunawan, Y. Cao, L. Petzold, and F. J. Doyle III. Stochastic sensitivity analysis of discrete stochastic biological systems. In *AIChE Annual Meeting*, Austin, TX, November 2004.
8. R. Gunawan and F. J. Doyle III. Isochron-based phase sensitivity analysis of biological oscillatory systems. In *AIChE Annual Meeting*, Cincinnati, OH, October 2005.
9. R. Gunawan, S. R. Taylor, and F. J. Doyle III. Sensitivity analysis in biological modeling: an application in the model development of staphylococcal enterotoxin B response. In *AIChE Annual Meeting*, Cincinnati, OH, October 2005.
10. T. M. Perumal, Y. Wu, and R. Gunawan. New *in silico* robustness analysis of cellular systems: a molecular perturbation approach. In *8th International Conference on Systems Biology*, Long Beach, CA, October 2007. (poster)
11. T. M. Perumal, Y. Wu, and R. Gunawan. *In silico* dynamical analysis of cellular systems: a molecular perturbation approach. In *10th International Conference on Molecular Systems Biology*, UP Dilliman, Quezon City, Philippines, February 2008. (poster)
12. T. M. Perumal, Y. Wu, and R. Gunawan. *In silico* dynamical analysis of cellular systems: a molecular perturbation approach. In *Annual International Conference on Research in Computational Molecular Biology* (RECOMB), Singapore, March 2008. (poster)
13. S. Poovathingal, J. Gruber, B. Halliwell, R. Gunawan. Aging studies: a stochastic approach. In *Annual International Conference on Research in Computational Molecular Biology* (RECOMB), Singapore, March 2008. (poster)
14. K. S. Ang and R. Gunawan. Parameter estimation for oscillatory biological systems. In *Annual International Conference on Research in Computational Molecular Biology* (RECOMB), Singapore, March 2008. (poster)
15. T. M. Perumal, Y. Wu, and R. Gunawan. Robustness analysis of cellular systems for *in silico* drug discovery. In *IFAC World Congress*, Seoul, South Korea, July 2008.
16. S. Poovathingal, J. Gruber, B. Halliwell, R. Gunawan. Aging Studies: A Stochastic Approach in point mutation dynamics in mouse model. In *AIChE Annual Meeting*, Philadelphia, PA, November 2008.
17. K. S. Ang and R. Gunawan. Parameter estimation of oscillatory biological systems. In *AIChE Annual Meeting*, Philadelphia, PA, November 2008. (poster)
18. S. Srinath and R. Gunawan. Identifiability analysis of metabolic networks. In *Intl. Conf. of Molecular Systems Biology*, Shanghai, PR China, July 2009.

19. S. K. Poovathingal and R. Gunawan. A Global Approach for Estimating the Kinetic Parameters of Stochastic Biological Systems. In *Foundations of Systems Biology and Engineering* (FOSBE), Denver, CO, August 2009. (poster)
20. T.M. Perumal and R. Gunawan, Information theoretic global robustness analysis of cellular systems: a molecular perturbation approach. In *Foundations of Systems Biology and Engineering* (FOSBE), Denver, CO, August 2009. (poster)
21. S. K. Poovathingal, J. Gruber, B. Halliwell and R. Gunawan, Stochasticity in mitochondrial DNA point mutations and its relevance in *Caenorhabditis elegans* aging. In *10th International Conference on Systems Biology*, Stanford, CA, September 2009. (poster)
22. T.M. Perumal and R. Gunawan, Information transfer in biological network motifs. In *10th International Conference on Systems Biology*, Stanford, CA, September 2009. (poster)
23. J. Gruber, S. K. Poovathingal, N. L. Fang, R. Gunawan and B. Halliwell, Deceptively simple – considerations regarding *Caenorhabditis elegans* lifespan, ageing and antioxidant studies. *Strategies for Engineered Negligible Senescence (SENS-4),* Cambridge, England, September 2009. (poster)
24. S. Srinath and R. Gunawan**,** Parameter Identifiability in Kinetic Modeling of Metabolic Pathways, In *Metabolic Engineering Conference VIII*, Jeju Island, South Korea, June 2010.
25. S. Srinath, Y. Zu and R. Gunawan, Identifiability Analysis of Decoupled Power-Law Models, In the *5th International Symposium on Design, Operation and Control of Chemical Processes (PSE Asia)*, Singapore, July 2010.
26. S. Srinath and R. Gunawan, Parameter Identifiability of Metabolic Network Models, In *Satellite Conference of the International Congress of Mathematics*, Hyderabad, India, August 2010.
27. Perumal TM and Gunawan R. In Analyzing the Complex Dynamics of Biochemical Pathways. In the satellite conference on *Application of Control Theory and Optimization Techniques in Biochemical Pathways*, HICC, Hyderabad, India, August 16-18, 2010.
28. L. N. Lakshmanan, S. K. Poovathingal, J. Gruber, B. Halliwell and R. Gunawan, Elucidating Mechanisms of Age-dependent Accumulation of Mitochondrial DNA Deletions – An *in silico* Approach. In *Gordon Research Conference on Biology of Aging*, Les Diablerets, Switzerland, August 2010. (poster)
29. Perumal TM and Gunawan R. Dynamical Analysis and Model Reduction of Complex Systems, In *13th Asia Pacific Confederation of Chemical Engineering Congress* (APCChE), Taipei, October 5-8, 2010.
30. S. K. Poovathingal, J. Gruber, B. Halliwell and R. Gunawan, Random Drift of Mitochondrial DNA Deletions in Sarcopenia, In *11th International Conference on Systems Biology*, Edinburgh, UK, October 2010. (poster)
31. S. K. Poovathingal, J. Gruber, B. Halliwell and R. Gunawan, Sarcopenia *in silico*. In *AIChE Annual Meeting*, Salt Lake City, UT, USA, November 2010.
32. Perumal TM and Gunawan R. Caveats of Parametric Sensitivity Analysis (PSA): In analyzing the dynamics of biological systems. In *AIChE Annual Meeting*, Salt Lake City, UT, USA, November 7-12, 2010.
33. Perumal TM and Gunawan R. Dynamical Model Reduction of Large Reaction Mechanisms: A Green's Function Matrix (GFM) Based Approach. In *AIChE Annual Meeting*, Salt Lake City, UT, USA, November 7-12, 2010.

STUDENTS SUPERVISION

Current Graduate Students

1. Suresh Kumar Poovathingal, PhD expected 2011 (co-supervisors: Dr. Jan Gruber and Prof. Barry Halliwell, Biochemistry, NUS)
2. Thanneer Malai Perumal, PhD expected 2011
3. Sridharan Srinath, PhD expected 2011
4. Laskhminarayanan Lakshmanan, PhD expected 2012
5. Zhi Yang Tam, PhD expected 2012
6. Gengjie Jia, PhD expected 2012 (co-supervisor: Prof. Gregory N. Stephanopoulos, MIT)
7. Kok Huei Seow, PhD expected 2013 (co-supervisor: Prof. H.-P. Too, Biological Science, NUS)

Graduated Students

1. Ang Kok Siong, M.Eng, 2010