Seunghee Shelly Jang

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Education

University of Washington
Ph.D. in progress, Electrical Engineering - Primary focus: Synthetic Biology — Present
Emphasis : Engineering multicellular behavior in *E. coli* and *S. cerevisiae*

University of British Columbia
M.A.Sc, Chemical and Biological Engineering — May 2009
Emphasis : Nonlinear System Identification with Bayesian Inference

University of Washington
B.S., Chemical Engineering — March 2007
Minor in Mathematics and Chemistry

Research Experience

University of Washington

Graduate Research Assistant — Sept. 2009–Present
Advisor : Dr. Eric Klavins — Dept. of Electrical Engineering.
Project : Engineering multi-cellular behavior in *E. coli*
Purpose : The bottom up approach of synthetic biology enables a complementary approach to traditional biological investigation and allows the identification of design principles of natural systems. In this project, I am focusing on engineering genetic regulatory networks (GRN) in *E. coli* that mimics differentiation phenomena in the early developmental stage of multicellular organisms. Starting from a high level specification of desired behavior, possible designs of GRN are analyzed and simulated. The simulation and quantitative analysis process informs and optimizes the tuning of synthetic circuit.

Project : System identification and quantitative analysis of *S. cerevisiae* synthetic auxin signaling pathway
Purpose : A large set of hormone signal pathway proteins from plants were ported into an orthogonal organism, S. cerevisiae. The native pathway generally forms a fixed architecture, but gives rise to quantitatively tunable response depending on the specific expression patterns of different proteins. To quantify this tunability, a mathematical model was identified using a minimal grey-box system identification approach. The characterization project yielded unique parameters for the tested protein pairs that can be used to design increasingly complex synthetic circuits. The next phase of the project focuses on exploring on the large design space available using these parts and selecting the network architectures that give rise to multicellular behavior in yeast.

University of British Columbia

Graduate Research Assistant — Sept. 2007–May 2009
Advisor : Dr. R. Bhushan Gopaluni — Dept. of Chemical & Biological Engineering.
Project : Nonlinear process parameter estimation using Bayesian inference and Markov Chain Monte Carlo approach
Purpose : Many chemical and biological processes are restricted by various physical and logistical factors and do not allow samples to be taken at regular time intervals in large quantity. The project developed an Bayesian inference algorithm that allow estimation of parameter probability distribution using a small number of irregularly sampled data from multiple experiments.

University of Washington

Undergraduate Research Assistant — Winter 2006–Summer 2007
Advisor : Dr. Buddy D. Ratner — Dept. of Biological Engineering
Project : Characterization and Analysis of polymer surface immobilized with amino acids
Purpose : Recent researches show that subcutaneous devices treated with CDI activated pHEMA immobilized with protein reduce foreign body capsule formation. The project focused on creating similar surfaces with various combination of amino acids in order to explore less costly alternative.

Undergraduate Research Assistant — Summer 2005
Advisor : Dr. Shaoyi Jiang — Dept. of Chemical Engineering
Project : Development of Surface Plasmon Resonance Biosensor
Purpose : The project focused on developing robust and highly sensitive sensors for diagnosing cancer and monitoring food safety with complex media composition.

Publications

Seunghee S. Jang, K. Oishi, R. Egbert and E. Klavins. "Specification and simulation of synthetic multi-celled behaviors. Journal of American Chemical Society", *ACS Synth. Biol.*, 2012

K. A. Havens*, J. M. Guseman*, **S. S. Jang***, E. Pierre-Jerome*, N. Bolten, E. Klavins and J. L. Nemhauser. "A synthetic approach reveals extensive tunability of auxin signaling." *Plant Physiology*, 2012. *The authors contributed equally to the paper.

S. S. Jang, R. B. Gopaluni, Parameter Estimation in Nonlinear Chemical Biological Processes with Unmeasured Variables, *Canadian Journal of Chemical Engineering*, 2011.

S. S. Jang, H. De La Hoz, A. Ben-Zvi, W. C. McCaffrey, R. B. Gopaluni, "Parameter estimation in nonlinear chemical and biological processes with unmeasured variables from small data sets ", *Chemical Engineering Science*, 2011.

S. S. Jang, H. De La Hoz, A. Ben-Zvi, R. B. Gopaluni, "Parameter Estimation using Scarce and Irregular data from Multiple Experiments", Proceedings of *Advanced Control in Industrial Process*, 2008.

Relevant Technical Skills

Modeling and analysis : Systems and control theory based modeling and analysis for biological systems. Includes theories of Markov processes, chemical master equations, bayesian inference, Markov Chain Monte Carlo methods, Nonlinear systems, stochastic simulations, parameter identification and model reduction.

Software : *Mathematica*, `gro`, MathWorks MATLAB, LaTeX, Mac OS X, Maple, MS-windows and others.

Biology Laboratory : DNA recombination techniques, plasmid construction, gene modification, cloning, transformations and cell culture. Fluorescence microscopy, microfluidic chambers, flow cytometery.

Biomaterials Laboratory : Toxicity screening, ESCA and ToF SIMS PCA analysis, manufacture and analysis of electrophoresis gel and polymer

Teaching Experience

Introduction to Synthetic Biology — Fall '11 UW
Dr. Eric Klavins — Dept. of Electrica Engineering
Description : Mathematical modeling of transcription, translation, regulation, and metabolism in cell; computer aided design methods for synthetic biology; implementation of information processing, Boolean logic and feedback control laws with genetic regulatory networks; modularity, impedance matching and isolation in biochemical circuits; and parameter estimation methods.

Biotechnology Laboratory Fall '08 UBC
Dr. Louise Creagh Dept. of Chemical and Biological Engineering
Description : Modern bioreactor technology, upstream and downstream processing of biotechnology products.

Process Synthesis Fall '08 UBC
Dr. Louise Creagh Dept. of Chemical and Biological Engineering
Description : Strategy for the conceptual design of industrial chemical and biological processes; rules of thumb for chemical engineers, simulation to assist process synthesis, reactor-separator network synthesis, introduction to product design and molecular structure design, efficiency and sustainability in the chemical industry.

Chemical & Biological Engineering Fall '07 UBC
Thermodynamics
Dr. Naoko Ellis Dept. of Chemical and Biological Engineering
Description : Volumetric and thermodynamic properties of fluids; equations of state; heat effects; ideal and non-ideal mixtures; fugacities and activity coefficients; vapor-liquid and liquid-liquid phase equilibrium; solubility of gases and solids in liquids; chemical reaction equilibrium; equilibrium partitioning of pollutants.

Presentations

"Engineering with auxin: characterization of a synthetic signal processing toolbox"
q-Bio 2012, Santa Fe, NM, USA. Aug 10, 2012.

"Parameter Estimation using Scarce and Irregular data from Multiple Experiments"
Advanced Control in Industrial Process, Jasper, AB, Canada. May 6, 2008.

"Parameter Estimation of Nonlinear Process Model using Multiple Experimental Data."
Control Systems/Pan Pacific - PAPTAC, Vancouver, BC, Canada. June 18, 2008

Honors and Awards

Kenney Fellowship University of Washington, 2012

Clairmont L. Egtvedt Fellowship University of Washington, 2009

Graduate Entrance Scholarship University of British Columbia, 2007

Kimberly-Clark Engineering Scholarship University of Washington, 2005

Dean's List University of Washington, 2002, 2003, 2004

Engineering Early Admission Student University of Washington, 2003