

FEIQIAO BRIAN YU

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EDUCATION

Stanford University, Stanford, CA

Doctor of Philosophy in Electrical Engineering 2010 – 2016

Advisers Professor Stephen R. Quake, Professor Mark A. Horowitz

Thesis *Characterizing bacterial physiology and diversity using microfluidic systems*

Master of Science in Electrical Engineering 2010 – 2012

California Institute of Technology, Pasadena, CA

Bachelor of Science in Electrical Engineering 2006 – 2010

Advisers Professor Yu-Chong Tai, Professor Changhuei Yang

RESEARCH EXPERIENCE

Ph.D. Candidate – Stanford Quake Lab

Mar 2011 – Dec 2016

Advisers: Professor Stephen R. Quake, Professor Mark A. Horowitz

- **Microfluidic-based Mini-Metagenomics Facilitates Discovery of Novel Bacteria**

We developed a microfluidic-based mini-metagenomic method to uncover genomes of new bacterial species from environmental samples. Mini-metagenomics increases throughput while maintaining single-cell resolution. The microfluidic platform facilitates automated lysis, DNA extraction and whole genome amplification. Using this method, we identified multiple draft genomes representing novel bacterial lineages from environmental samples and assessed abundance, function, and genome variation in the community.

- **Single-Cell Cyanobacterial Growth Dynamics Using Microfluidic Cell Culture System**

Synechocystis is a cyanobacterium essential in global nutrient cycles. We developed a microfluidic setup and a custom image analysis pipeline to investigate single-cell growth under continuous illumination and alternating light-dark periods. Our data demonstrated exponential growth and revealed an adder based cell size regulation mechanism, where a constant volume is added during each cell cycle. We found that cell growth and division only occur under light, but dark periods do not alter underlying mechanisms of cell cycle control. Our technique is applicable to many slow-growing, non-rod-shaped cells, and our findings describe growth kinetics of *Synechocystis* that suggest how light may affect cell cycle at the single-cell level.

- **Microfluidic Digital to Analog Converter for Flexible On-Chip Control**

Multilayer PDMS (polydimethylsiloxane) microfluidics offer throughput and automation to biological and chemical experiments. However, control components for such devices are limited to digital switches. We designed and fabricated a microfluidic serial digital to analog pressure converter to accurately convert a constant external pressure source into different on-chip pressures, allowing versatile on-chip flow control.

Undergraduate Research Assistant – Caltech Biophotonics Laboratory

Jun 2009 – Jun 2010

Adviser: Professor Changhuei Yang

- **Opto-fluidic Chamber for Studying Cell Migration**

In this senior thesis project, I fabricated a single layer PDMS microfluidic device with integrated metal electrodes and micro-wells for storing and releasing chemicals during microfluidic cell culture experiments. Metal electrodes act as heaters melting wax and releasing

chemicals into the culturing chamber. Finally, coupled to an optical sensor, this device can potentially become a portable opto-fluidic platform for monitoring cell migration.

Undergraduate Research Assistant – Caltech Micromachining Laboratory

Jun 2008 – Jun 2010

Adviser: Professor Yu-Chong Tai

○ **Slant tethered bioMEMS check valve**

Implantable microfluidic devices require check valves with high cracking pressures. This project demonstrates a new method for fabricating high cracking pressure check valves based on thin parylene films. Check valves with different cracking pressures can be obtained by tuning temperature and time of the thermal annealing step after parylene coating.

○ **Parylene Stiction to Various Surfaces**

Cracking pressure of MEMS based passive check valves depends on stiction – surface adhesion between parylene film and the underlying substrate. This study systematically assesses stiction between thin parylene films and different substrate surfaces using MEMS based blister test. Results demonstrate that mechanical roughening and high-energy surface coating can significantly reduce stiction.

○ **Characterization of biocompatible and passive parylene intraocular pressure actuator**

Glaucoma is an ocular disease affecting over 60 million people worldwide. High intraocular pressure (IOP) due to the inability to drain aqueous humor often result in optic nerve damage and potentially loss of sight. We fabricated a parylene coated, implantable intraocular pressure actuator combining a normally closed and normally open MEMS check valves. We further characterized its ability to regulate IOP.

Undergraduate Research Assistant – Caltech Bronner Lab

Jun 2007 – Sep 2007

Adviser: Professor Marianne E. Bronner

○ **Evolution of the Vertebrate Jaw**

Appearance of the vertebrate jaw is a key event in vertebrate evolution, allowing the capture of large, motile prey. The vertebrate jaw consists of dorsal and ventral segments connected by a joint. How such structure evolved is unknown. This project investigated the spatial expression of 3 joint development genes (Bapx, Gdf, and Goosoid) in embryos of lamprey, a jawless vertebrate, using in-situ hybridization and mRNA knockout. We found that lamprey embryos lack Bapx and Gdf expression in the pharyngeal arches.

TEACHING EXPERIENCE

Stanford Undergraduate Research Mentor

Jun 2013 – Jun 2016

- Supervised undergraduate senior thesis for one Stanford bioengineering student investigating viral diversity in environmental microbial samples.
- Mentored one first year graduate student in the Department of Physics
- Mentored two Stanford undergraduate summer research students in developing an open source, remote microfluidic valve controller for pressure-driven multilayer microfluidic devices

Lecturer for Graduate Level Microfluidic Fabrication Class

Jan 2013 – Mar 2014

- Held lectures on microfluidic fabrication, testing techniques and applications
- Taught lab sessions fabricating a two layer microfluidic rotary pump
- Guided group projects including brainstorming, designing, fabricating, and testing multilayer PDMS microfluidic devices for chemical or biological applications

Teaching Assistant for Electrical Engineering Laboratory

Jan 2014 – Mar 2014

- Purchased supplies required for each Arduino based project
- Prepared project handouts and homework exercises

- Taught students how to design, test, and debug electronic hardware

Teaching Assistant for Feedback and Control Class

Mar 2009 – Jun 2010

- Held regular office hours and provided additional help for lab exercises
- Updated the lecturer on student performances and provided recommendations

WORK EXPERIENCE

Apple Inc. Hardware Intern

Jun 2012 – Sept 2012

- Brainstormed rapid testing solutions for assembled units of the Force Touch Track Pad
- Constructed two testing prototypes and characterized their performance
- Presented both testing platforms to the product team, one of which was implemented

Apple Inc. Hardware Intern

Jun 2011 – Sept 2011

- Characterized performance of an early prototype of the Apple Pencil
- Provided suggestions for improved user experience from hardware and software aspects
- Completed an improved prototype for a product demo to upper level management

SERVICE ACTIVITIES

Design of a Maker Style Electrical Engineering Laboratory Course

Nov 2013 – Mar 2014

- Brainstormed project ideas and engineering concepts for the class
- Designed and implemented two projects: an EKG sensor and a LED cube

Student Faculty Conference Electrical Engineering Committee

Jan 2009 – Apr 2009

- Led a student based committee to gather undergraduate feedback on required courses
- Drafted proposal for improving the undergraduate curriculum
- Implemented changes to the undergraduate curriculum including addition of an undergraduate seminar introducing students to different research areas in Electrical Engineering

AWARDS

- ASM Microbe 2016 Outstanding Student Abstract Jun 2016
- Donald O. Pederson Best Paper Award for *IEEE Transactions on Computer Aided Design* Jun 2015
- NSF Graduate Fellowship Apr 2011
- Stanford Graduate Fellowship Mar 2010
- Hertz Fellowship Finalist Feb 2010
- Best Paper at the 5th IEEE NEMS Conference in Xiamen, China Jan 2010
- Tau Beta Pi Scholarship Apr 2009
- Caltech Summer Undergraduate Research Fellowship 2007 – 2009

JOURNAL PUBLICATIONS

1. **Yu FB**, Blainey P, Schulz F, Woyke T, Horowitz MA, Quake SR, “Microfluidic-based mini-metagenomics enables discovery of novel microbial lineages from complex environmental samples,” *(submitted)*
2. **Yu FB**, Willis L, Chau R, Zambon A, Horowitz MA, Bhaya D, Huang KC, Quake SR, “Long-term microfluidic tracking of coccoid cyanobacterial cells reveals robust control of division timing,” *BMC Biology*, vol 15, issue 1, pp. 11, February 2017.
3. Hu K, **Yu F**, Ho TY, Chakrabarty K, "Testing of Flow-Based Microfluidic Biochips: Fault Modeling, Test Generation, and Experimental Demonstration," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, vol 33, issue 10, pp. 1463-1475, October 2014.

4. **Yu F**, Horowitz MA, Quake SR, "Microfluidic serial digital to analog pressure converter for arbitrary pressure generation and contamination-free flow control," *Lab on a Chip*, vol. 13, pp. 1911-8, May 21 2013.
5. Cerny R, Cattell M, Sauka-Spengler R, Bronner-Fraser M, **Yu F**, Medeiros DM, "Evidence for the prepattern/cooption model of vertebrate jaw evolution," *Proceedings of the National Academy of Sciences of the United States of America*, vol. 107, pp. 17262-17267, Oct 5 2010.

CONFERENCE PUBLICATIONS

1. **Yu F**, Horowitz MA, Quake SR, "High throughput microfluidic sample preparation for metagenomic analysis," *Proceedings of the 18th International Conference on Miniaturized Systems for Chemistry and Life Sciences (MicroTAS 2014)*, San Antonio, U.S.A., October 2014, pp. 129-131.
2. **Yu F**, Horowitz MA, Quake SR, "Robust Layout Techniques Decrease Volume Injection and Capacitive Mismatch due to Alignment Errors," *Proceedings of the 17th International Conference on Miniaturized Systems for Chemistry and Life Sciences (MicroTAS 2013)*, Freiburg, Germany, November 2013, pp. 940-942.
3. **Yu F**, Song K, Horowitz MA, Quake SR, "Single Cell Tracking of Synechocystis Growth in a Microfluidic Culture Device Using a Probabilistic Automated Image Analysis Technique," *Proceedings of the 17th International Conference on Miniaturized Systems for Chemistry and Life Sciences (MicroTAS 2013)*, Freiburg, Germany, November 2013, pp. 1689-1691.
4. **Yu F**, Kibardin V, Horowitz MA, Quake SR, "Microfluidic Serial DAC for Analog Pressure Generation," *Proceedings of the 16th International Conference on Miniaturized Systems for Chemistry and Life Sciences (MicroTAS 2012)*, Okinawa, Japan, November 2012, pp. 70-72.
5. Lin JCH, **Yu F**, Tai YC, "Integration of slanted tether check-valves for high pressure applications," *Proceedings of 6th IEEE International Conference on Nano/Micro Engineered and Molecular Systems (NEMS 2011)*, Kaohsiung, Taiwan, February 2011, pp. 715-718.
6. Lin JCH, **Yu F**, Tai YC, "Cracking pressure control of parylene check valve using slanted tensile tethers," *Proceedings of 23rd IEEE International Conference on Micro Electro Mechanical Systems (MEMS 2010)*, Hong Kong, China, January 2010.
7. **Yu F**, Lin JCH, Chen PJ, Tai YC, "Parylene stiction," *Proceedings of 23rd IEEE International Conference on Micro Electro Mechanical Systems (MEMS 2010)*, Hong Kong, China, January 2010.
8. Lin JCH, **Yu F**, Saati S, Varma R, Humayun MS, Tai YC, "Ex vivo implantation study of minimally invasive glaucoma drainage device," *Proceedings of the 5th IEEE International Conference on Nano/Micro Engineered and Molecular Systems (NEMS 2010)*, Xiamen, China, January 2010.
9. **Yu F**, Lin JCH, Chen PJ, Tai YC, "Stiction of parylene C to silicon surface measured using blister tests," *Proceedings of the 5th IEEE International Conference on Nano/Micro Engineered and Molecular Systems (NEMS 2010)*, Xiamen, China, January 2010.
10. Lin YCH, Chen PJ, **Yu B**, Humayun M, Tai YC, "Minimally Invasive Parylene Dual-Valved Flow Drainage Shunt for Glaucoma Implant," *Proceedings of 22nd IEEE International Conference on Micro Electro Mechanical Systems (MEMS 2009)*, Sorrento, Italy, January 2009, pp. 196-199.

INVITED SEMINARS AND LECTURES

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| 1. Hopkins Marine Station; Hopkins Genomic Club Seminar | March 22, 2016 |
| 2. Santa Clara University; Department of Bioengineering | February 10, 2016 |
| 3. Joint Genome Institute; Science and Technology Seminar | July 29, 2015 |