

DAVID K. KARIG, Ph.D.

301 Rhodes Hall, Clemson, SC 29634-0905

Phone: (443)280-7975

E-mail: dkarig@clemson.edu

Education

- Ph.D., Princeton University, Electrical Engineering, 2007
Thesis: *Engineering Multi-Signal Synthetic Biological Systems*. Advisor: Dr. Ron Weiss
- M.A., Princeton University, Electrical Engineering, 2002
- B.S., Clemson University, *summa cum laude*, Electrical Engineering, 2000
Thesis: *Wavelet Analysis of Electrocardiograph Signals*. Advisor: Dr. Ernest G. Baxa, Jr.

Work Experience

- Associate Professor, Clemson University, Department of Bioengineering, 2018-present
- Senior Professional Staff Temp-on-call, Johns Hopkins University Applied Physics Lab, Research and Exploratory Development Department, 2018-present
- Senior Professional Staff and Project Manager, Johns Hopkins University Applied Physics Lab, Research and Exploratory Development Department, 2012-2018
- Post-doctoral Research Associate, Oak Ridge National Laboratory, 2008-2012
Advisor: Dr. Michael L. Simpson
- Fellow and Graduate Assistant, Princeton University, 2000-2007
- Summer Intern, HP Labs, Palo Alto, CA, 2001
- Summer Intern, Space and Naval Warfare Systems Center (SPAWAR), Charleston, SC, 1998

Teaching Experience

- Instructor, BIOE 4470/6470, Synthetic Biology Fundamentals, Fall 2020
- Instructor, BIOE 4500, Synthetic Biology Fundamentals, Spring 2020
- Instructor, BIOE 8500, Introduction to Synthetic Biology, Fall 2019
Developed and taught a new course in Synthetic Biology.
- T.A., ELE 206, Introduction to Logic Design, Spring 2004
Held help sessions and office hours. Prepared and graded exams and assignments.
- T.A., ELE 101, Computing for a Mobile World, Spring 2003
Planned and conducted hands-on programming precepts and held office hours. Prepared and graded exams, assignments, and a final project.
- T.A., ELE 391, The Wireless Revolution: Telecommunications for the 21st Century, Spring 2001 and Spring 2002. Held office hours and helped grade assignments, exams, and a final paper.

Awards

- Publication Award for Outstanding Special Publication, Johns Hopkins University Applied Physics Laboratory, 2018
- Lawrence R. Hafstad Fellow, Johns Hopkins University Applied Physics Laboratory, 2017-2018
- BioBricks Foundation SB5.0 Young Researcher Travel Award, June 15-17, 2011

- PICASso (Program in Integrative Information, Computer and Application Sciences) Fellowship
Fall 2004 - Spring 2005
- Best student paper, International Conference on Information Technology: Research and Education
(ITRE). Newark, New Jersey, August 2003
- Department of Defense NDSEG Fellowship, Fall 2000 - Spring 2003
- Best student paper, Eighth International Meeting on DNA Based Computers. Hokkaido
University, Japan, June 2002

Journal Publications

Timm C, Loomis K, Stone W, Mehoke T, Brensinger B, Pellicore M, Staniczenko P, Charles C, Nayak S, **Karig D**. Isolation and characterization of diverse microbial representatives from the human skin microbiome. 2020. *Microbiome* 8:1-12.

Mainali KP, Bewick S, Vecchio-Pagan B, **Karig D**, Fagan W. Detecting interaction networks in the human microbiome with conditional Granger causality. 2019. *PLOS Comp Biol* 15(5):e1007037.

Bewick S, Gurarie E, Beattie J, Daviti C, Flint R, Mehoke T, Thielen P, Breitweiser F, **Karig D**, and Fagan W. Trait-Based Analysis of the Human Skin Microbiome. 2019. *Microbiome* 7(1):101.

Karig D*, Martini KM*, Lu T*, DeLateur N, Goldenfeld N, Weiss R. Stochastic Turing patterns in a synthetic bacterial population. 2018. *Proc Natl Acad Sci USA* 201720770. (*equal contribution authors)

Tsoi R, Wu F, Zhang C, Bewick S, **Karig D**, You L. Metabolic Division of Labor In Microbial Systems. 2018. *Proc Natl Acad Sci USA* 201716888.

Timm CM, Lloyd EP, Egan A, Mariner R, **Karig D**. Direct Growth of Bacteria in Headspace Vials Allows for Screening of Volatiles by Gas Chromatography Mass Spectrometry. *Frontiers in microbiology* 9 (2018): 491.

Vecchio-Pagan B, Bewick S, Mainali K, **Karig D**, Fagan WF. Ecological Stoichiometry of the Human Microbiome. 2017. *Frontiers in Microbiology* 8:1119.

Karig DK, Bessling S, Thielen P, Zhang S, Wolfe J. Heat-stable preservation of protein expression systems for portable therapeutics production. 2017. *Journal of the Royal Society Interface* 14(129):20161039.

Karig DK. Cell-free synthetic biology for environmental sensing and remediation. 2017. *Current Opinion in Biotechnology* 45:69-75.

Mainali KP, Bewick S, Thielen P, Mehoke T, Breitwieser FP, Paudel S, Adhikari A, Wolfe J, Slud EV, **Karig D**, Fagan WF. 2017. Statistical analysis of co-occurrence patterns in microbial presence-absence datasets. *PLoS one* 12(11):e0187132.

Bewick S, Thielen P, Mehoke T, **Karig D**, and Fagan W. Sampling, Sequencing, and the SAD. 2017. *Ecological Complexity*.

Bewick S, Staniczenko PA, Li B, **Karig D**, and Fagan W. Invasion Speeds in Microbial Systems with Toxin Production and Quorum Sensing. 2017. *Journal of Theoretical Biology* 420:290-303.

Lopatkin AJ, Huang S, Smith RP, Srimani JK, Sysoeva TA, Bewick S, **Karig DK**, You L. Antibiotics as a selective driver for conjugation dynamics. 2016. *Nature Microbiology* 16044.

Karimi A, **Karig D**, Kumar A, Ardekani AM. Interplay of physical mechanisms and biofilm processes: review of microfluidic methods. 2015. *Lab Chip* 15 (1):23-42.

Iyer S*, **Karig DK***, Norred SE, Simpson ML, Doktycz MJ. Multi-input regulation and logic with T7 promoters in cells and cell-free systems. 2013. *PLOS One* 8(10):78442. (*equal contribution authors)

Karig DK, Jung SY, Srijanto B, Collier CP, Simpson ML. Probing cell-free gene expression noise in femtoliter volumes. 2013. *ACS Synth Biol* 2(9):497-505.

Kumar A, **Karig D**, Acharya R, Neethirajan S, Mukherjee PP, Retterer S, Doktycz MJ. Microscale confinement features can affect biofilm formation. 2013. *Microfluidics and Nanofluidics* 14(5):895-902.

Karig DK, Iyer S, Simpson ML, Doktycz MJ. Expression optimization and synthetic gene networks in cell-free systems. 2012. *Nucleic Acids Research* 40(8):3763-3774.

Karig DK, Siuti P, Dar RD, Retterer ST, Doktycz MJ, Simpson ML. Model for biological communication in a nanofabricated cell-mimic driven by stochastic resonance. 2011. *Nano Communication Networks* 2(1):39-49.

Dar RD, **Karig DK**, Cooke JF, Cox CD, Simpson ML. Distribution and regulation of stochasticity and plasticity in *Saccharomyces cerevisiae*. 2010. *Chaos* 20:037106.

Simpson ML, Cox CD, Allen MS, McCollum JM, Dar RD, **Karig DK**, and Cooke JF. Noise in biological circuits. 2009. *WIREs Nanomed Nanobiotechnol* 1:214-225.

Karig DK and Simpson ML. Tying new knots in synthetic biology. 2008. *HFSP Journal* 2:124-128.

Brenner K*, **Karig DK***, Weiss R, Arnold FH. Engineered bidirectional communication mediates a consensus in a microbial biofilm consortium. 2007. *Proc Natl Acad Sci USA* 104:17300-17304. (*equal contribution authors)

Andrianantoandro E*, Basu S*, **Karig DK***, and Weiss R. Synthetic biology: new engineering rules for an emerging discipline. 2006. *Mol Syst Biol* 2:2006.0028. (*equal contribution authors)

Karig D and Weiss R. Signal-amplifying genetic circuit enables in vivo observation of weak promoter activation in the Rhl quorum sensing system. 2005. *Biotechnol Bioeng* 89(6):709-18.

Weiss R, Basu S, Hooshangi S, Kalmbach A, **Karig D**, Mehreja R and Netravali I. Genetic circuit building blocks for cellular computation, communications, and signal processing. 2003. *Natural Computing* 2(1): 47-84.

Basu S, **Karig D**, and Weiss R. Engineering signal processing in cells: towards molecular concentration band detection. 2003. *Natural Computing* 2(4): 463-478.

Peer Reviewed Conference Proceedings

Kumar A, **Karig D**, Neethirijan S, Suresh AK, Srijanto BR, Mukherjee PP, Retterer S, Doktycz MJ. Adhesion and formation of microbial biofilms in complex microfluidic devices. 2012. *Proceedings of the 3rd ASME Micro/Nanoscale Heat and Mass Transfer International Conference*.

Hsu A, Vijayan V, Fomundam L, Gerchman Y, **Karig D**, Hooshangi S, Basu S, and Weiss R. Dynamic control in a coordinated multi-cellular maze solving system. 2005. *American Controls Conference*.

Basu S, **Karig D**, and Weiss R. Engineering signal processing in cells: towards molecular concentration band detection. 2002. *Eighth International Meeting on DNA Based Computers*, pp. 61-72.

McGregor JP, **Karig DK**, Shi Z, and Lee RB. A processor architecture defense against buffer overflow attacks. 2003. *Proceedings of the IEEE International Conference on Information Technology: Research and Education (ITRE)*, pp. 243-250.

Lee RB, **Karig DK**, McGregor JP, and Shi Z. Enlisting hardware architecture to thwart malicious code injection. 2003. *Proceedings of the International Conference on Security in Pervasive Computing (SPC-2003)*, pp. 237-252.

Book Chapters and Technical Reports

Bewick S, **Karig D** and Fagan WF. Contamination Issues in Microbiome Sequencing Studies. from: *Microbial Ecology: Current Advances from Genomics, Metagenomics and Other Omics* (Edited by: Diana Marco). 2019. Caister Academic Press, U.K. Pages: 13-26.

Neethirajan S, **Karig D**, Kumar A, Mukherjee PP, Retterer ST, Doktycz MJ. 2012. Biofilms in microfluidic devices. 2012. *Encyclopedia of Nanotechnology*, Ed: B. Bhushan, Springer, New York.

Karig D and Lee RB. Remote denial of service attacks and countermeasures. 2001. *Princeton University Department of Electrical Engineering Technical Report CE-L2001-002*.

Invited Talks

Karig, D. "The Human Skin Microbiome - from Understanding to Applications." Invited talk at Tri-Services Microbiome Consortium Symposium, Wright-Patterson Air Force Base, Fairborn, OH. (October 23, 2019).

Karig, D. "The Human Skin Microbiome - from Understanding to Applications." Invited talk at Tri-Services Microbiome Consortium Topical Meeting, Framingham State University. Framingham, MA. (June 4, 2019).

"Cell-Free Synthetic Biology for Therapeutics, Sensing, and Remediation," 15th Annual PEGS Boston, Boston, MA (April 12, 2019).

"Understanding the Human Skin Microbiome," Tri-Service Microbiome Consortium Workshop, Bethesda, MD (May 8, 2018).

“Understanding the Human Skin Microbiome through Integration of Metagenomics, Bioinformatics, Spatial Ecology and Synthetic Biology,” Tri-Service Microbiome Consortium Workshop, Rockville, MD (May 10, 2017).

“Microbiomes – Understanding Normal States to Identify Disease and Disease Risk,” Computational Biology Conference, Mayo Clinic (July 7, 2016).

“Engineering Multispecies Consortia,” DHS Biofutures Workshop, Arlington, VA (January 29, 2015).

“Synthetic Biology at Multiple Scales,” Johns Hopkins University Biomedical Engineering Seminar, Johns Hopkins University (November 13, 2014).

“Addressing the Challenges of Building Synthetic Biological Systems,” Baltimore Underground Science Space, Baltimore, MD (April 11, 2014).

“Expression Optimization and Synthetic Gene Networks in Cell-Free Systems,” PepTalk: The Protein Science Week, Palm Springs, CA (January 25, 2013).

“Cell-free Synthetic Biology,” DTRA Cellular Sensing Systems Conference, Scottsdale, AZ (December 4, 2012).

“Cell-free synthetic biology in nanofabricated reaction devices,” Stochastic Processes in Cell and Population Biology, Mathematical Biosciences Institute at Ohio State University (October 27, 2011).

“Bacterial Networks - Joining the Strengths of Structural and Systems Biology to reach 'Synthetic' Biology” (plenary talk), European Science Foundation Symposium, Sant Feliu de Guixols, Spain (October 19, 2006).

Patents

D. Karig. “Preservation and reconstitution of cell-free protein expression systems.” US Patent 9,937,239. Issued April 10, 2018.

D. Karig and J. Wolfe. “Programmed droplet rupture for directed evolution.” US Patent 10,260,064. Issued April 16, 2019.

Professional Activities

- Reviewer for NASA Interdisciplinary Consortia for Astrobiology Research (ICAR) proposals, 2020
- Search Committee Chair for Lecturer hire, 2018-2019
- Honors and Awards Committee member, 2018-2020
- Search Committee member, 2019-2020
- Briefed APL Executive Council, JHU Board of Managers, and Buzz Aldrin on “Functional Biology,” October-November, 2014
- Chaired session on "Engineering for High-Throughput and Enhanced Performance" at PepTalk 2013 Conference
- Founding member, Institutional Biosafety Committee, JHUAPL, 2013-present
- Member of AAAS

- Reviewer for Journal of Theoretical Biology, FEBS Letters, Scientific Reports, Biotechnology and Bioengineering, and ACS Synthetic Biology, Frontiers in Cellular and Infection Microbiology, ACS Sensors, and Analytical Chemistry
- Co-organized and arranged speakers for PICASSo Interdisciplinary Computational Seminar Series, Princeton University, Fall 2004 and Spring 2005
- Participated in CBSSS (Computing Beyond Silicon Summer School), Caltech, June 17-July 17, 2002

Current Funding

ARO Multidisciplinary University Research Initiative. “Understanding the Skin Microbiome through the Integration of Metagenomics, Bioinformatics, Spatial Ecology, and Synthetic Biology.” \$7,609,560. 08/01/14-04/30/21. PI: D. Karig; co-PI’s: S. Nayak, J. Wolfe, S. Salzberg, L. You, and W.F. Fagan.

Past Funding

Lawrence R. Hafstad Fellowship, JHUAPL. \$39,000.
10/01/15-09/30/18. PI: D. Karig.

Internal Research and Development, JHUAPL.
“Skin Microbiota Signatures of Exposure and Effects on the Host.” \$100,000.
10/01/17-09/30/18. PI: K. Loomis; co-PI: D. Karig.

Johns Hopkins Discovery Award. “Sequencing-based Transcription Factor Binding Quantification for Synthetic Biology.” \$98,287. 07/01/15-2/28/17. PI’s: D. Karig and W. Timp.

Internal Research and Development, JHUAPL. “Spatiotemporal in vivo Imaging of Gut Microbes.” \$65,000. 10/01/15-09/30/16. PI’s: D. Karig and P. Thielen.

Internal Research and Development, JHUAPL. “Biomaterial Patterning at Multiple Scales.” \$330,000. 10/01/15-09/30/17. PI’s: D. Karig and R. Jacak.

Internal Research and Development, JHUAPL. “Engineering Wild Microbes.” \$200,000. 10/01/16-09/30/17. PI’s: D. Karig, J. Dymond, and R. Jacak.

Internal Research and Development, JHUAPL. “Cell-free Synthetic Biology.” \$260,000. 02/12/13-09/30/14. PI: D. Karig.

Internal Research and Development, JHUAPL. “Engineered Biological Pattern Formation.” \$70,000. 10/01/13-09/30/14. PI: D. Karig.