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RESEARCH INTERESTS

Emergent dynamics within and among cell populations; multi-scale, multi-class computational models of dynamic life systems; network inference of cellular regulation; (machine) learning from biological data; entrainment & control.

EDUCATION

- **Postdoc** in Biological Engr, Massachusetts Institute of Technology 2008–2011
Advisor: Prof. Douglas A. Lauffenburger
- **Ph.D.** in Electrical & Computer Engr, University of California Santa Barbara 2002–2007
Advisor: Prof. Francis J. Doyle III

APPOINTMENTS

- **Assoc Professor**, Biology and Chemical Engineering, **University of Washington** 2020–
- **Adjunct Associate Professor**, Chemical & Biological Engineering, **Northwestern University** 2019–
- **Sr Advisor of Modeling, Dissemination, & Alliances**, Allen Institute for Cell Science 2019–
- **Asst Professor**, Biology and Chemical Engineering, **University of Washington** 2019–2020
- **Asst Professor**, Chemical & Biological Engineering, **Northwestern University** 2012–2019
Secondary appointment in Feinberg School of Medicine Department of Pulmonary and Critical Care

ACADEMIC AFFILIATIONS

- University of Washington Computational Molecular Biology Program 2019–
- Northwestern University NSF-Simons Center for Quantitative Biology 2018–2019
- Northwestern University Center for Synthetic Biology 2017–2019
- Northwestern University Institute of Complex Systems 2012–2019
- Northwestern University Chemistry of Life Processes Institute 2012–2019
- Northwestern University Interdisciplinary Biological Sciences Program 2012–2019
- Northwestern University Biotechnology Training Program 2012–2019

SCIENCE ADVISORY BOARD MEMBERSHIPS

- NSF Science and Technology Center for Cellular Construction 2017–
Partnership among UCSF, UC Berkeley, SF State, Stanford, and IBM
- Allen Institute for Cell Science 2018–2019
- Immuneering Corporation 2012–2018

HONORS & AWARDS

- **Plenary Speaker** at the International Federation of Automatic Control (IFAC) symposium on Dynamics and Control of Process Systems (DYCOPS) 2022
- **Distinguished Investigator**, Washington Research Foundation 2019
- **Senior Moulton Medal**, Institution of Chemical Engineers best paper award for 2019 2020
- **Keynote Speaker** at Foundations of Systems Biology in Engineering Conference (Valencia, Spain) 2019
- **Paul G Allen Frontiers Symposium Speaker** on Predicting Biology 2019
- **Mindlin Public Lecture** at University of Washington 2019
- **Distinguished Speaker** for the Accelerated Discovery Forum at IBM Research-Almaden 2018
- **NSF CAREER Award**, National Science Foundation Directorate for Engineering 2017
- **Keynote Speaker** at 15th International Conference on Molecular Systems Biology (Raitenhaslach, Germany) 2017
- **Cornew Innovation Award**, Northwestern University Chemistry of Life Processes 2014
- **Northwestern University Searle Fellow**, Searle Scholars Teaching Program 2013
- **Best Paper Award**, Computers and Chemical Engineering 2006
- **Research Fellow**, Air Force Research Laboratory 2005
- **NSF Integrative Graduate Education and Research Trainee** 2004
- **IEEE Control Systems Magazine Featured Student** 2004

PUBLICATIONS

[Link to NCBI public bibliography.](#) Corresponding author(s) underlined; *Co-first authors.

36. Cain J.Y., Yu J.S., **Bagheri N.** The in silico lab: Improving academic code using lessons from biology. *Cell Syst.* 14(1):1-6, 2023. DOI: 10.1016/j.cels.2022.11.006
35. Prybutok A.N., Yu J.S., Leonard J.N., **Bagheri N.** Mapping CAR T-cell design space using agent-based models. *Front Mol Biosci.* 9(849363), 2022. DOI: 10.3389/fmolb.2022.849363
34. Prybutok A.N.*, Cain J.Y.*, Leonard J.N., **Bagheri N.** Fighting fire with fire: deploying complexity in computational modeling to effectively characterize complex biological systems. *Curr Opin Biotechnol.* 75(102704), 2022. DOI: 10.1016/j.copbio.2022.102704. **Invited review.**
33. **Bagheri N.**, Carpenter A.E., Lundberg E., Plant A.L., Horwitz R. The new era of quantitative cell imaging—challenges and opportunities. *Molecular Cell.* 82(2), 2022. DOI: 10.1016/j.molcel.2021.12.024
32. Dray K.E., Muldoon J.J., Mangan N.M., **Bagheri N.**, Leonard J.N. GAMES: A dynamic model development workflow for rigorous characterization of synthetic genetic systems. *ACS Synthetic Biology.* 2022. DOI: 10.1021/acssynbio.1c00528.
31. Yu J.S., **Bagheri N.** Modular microenvironment components reproduce vascular dynamics *de novo* in a multi-scale agent-based model. *Cell Syst.* 12(8):795–809, 2021. DOI: 10.1016/j.cels.2021.05.007. **Cover story.**
30. Muldoon J.J., Kandula V., Hong M., Donahue P.S., Boucher J.D., **Bagheri N.**, Leonard J.N. Model-guided design of mammalian genetic programs. *Sci Adv.*, 2021. DOI: 10.1126/sciadv.abe9375.
29. Yu J.S., **Bagheri N.** Agent-based models predict emergent behavior of heterogeneous cell populations in dynamic microenvironments. *Front Bioeng Biotechnol.*, 2020. DOI: 10.3389/fbioe.2020.00249.
28. Bernasek S.M., Peláez N., Carthew R.W., **Bagheri N.**, Amaral L.A.N. Fly-QMA: Automated analysis of mosaic imaginal discs in *Drosophila*. *PLoS Comp Biol.*, 2020. DOI: 10.1371/journal.pcbi.1007406.
27. Muldoon J.J., Chuang Y., **Bagheri N.**, Leonard J.N. Macrophages employ quorum licensing to regulate collective activation. *Nat Comm.*, 2020. DOI: 10.1038/s41467-020-14547-y.
26. Donahue P.S., Draut J.W., Muldoon J.J., Edelstein H.I., **Bagheri N.**, Leonard J.N. COMET: A toolkit for composing custom genetic programs in mammalian cells. *Nat Comm.*, 2020. DOI: 10.1038/s41467-019-14147-5.
25. Cassidy J.J.*, Bernasek S.M.*, Bakker R., Pelaez N., Eder B., Bobrowska A., **Bagheri N.**, Amaral L.A.N., Carthew R.W. Repressive gene regulation synchronizes sensory organ development with cellular metabolism in *Drosophila*. *Cell*, 2019. PMID: 31353220.
24. Xue A.Y.*, Yu A.*, Lucks J., **Bagheri N.** DUETT quantitatively identifies unknown events in nascent RNA structural dynamics from chemical probing data. *Bioinformatics*, 2019. DOI:10.1093/bioinformatics/btz449.
23. Finkle J.D., **Bagheri N.** Analysis of gene expression dynamics offers quantitative models and regulatory insights of transcription in the *PI3K* pathway. *Bioinformatics*, 2019. DOI:10.1093/bioinformatics/btz256.
22. Muldoon J.J.*, Yu J.S.*, Fassia M.K., **Bagheri N.** Network inference performance complexity: a consequence of topological, experimental, and algorithmic determinants. *Bioinformatics*, 2019. DOI:10.1093/bioinformatics/btz105.
21. Yamankurt G., Berns E.J., Xue A.Y., Lee A., **Bagheri N.**, Mrksich M., Mirkin C.A. Addressing Nanomedicine Complexity Through Novel High-Throughput Screening and Machine Learning. *Nat Biomed Eng.*, 2019. DOI:10.1038/s41551-019-0351-1
20. Bucior B.J., Bobbitt N.S., Islamoglu T., Goswami S., Gopalan A., Yildirim T., Farha O.K., **Bagheri N.**, Snurr R.Q. Energy-based descriptors to rapidly predict hydrogen storage in metal-organic frameworks. *Mol Syst Des Eng.*, 2019. DOI:10.1039/C8ME00050F.
19. Walter J.M.*, Ren Z.*, Yacoub T., Reyfman P.A., Shah R.D., Abdala-Valencia H., Nam K., Morgan V.K., Anekalla K.R., Joshi N., McQuattie-Pimentel A.C., Chen C.-I., Chi M., Han S.H., Gonzalez F.J., Soberanes S., Watanabe S., Williams K.J.N., Lu Z., Paonessa J., Hountras P., Breganio M., Borkowski N., Donnelly H.K., Allen J.P., Amaral L.A.N., Bharat A., Misharin A.V., **Bagheri N.**, Hauser A., Budinger G.R.S., Wunderink R.G. Multidimensional assessment of the host response in mechanically ventilated patients with suspected pneumonia. *Am J Respir Crit Care Med.*, 2018. PMID: 30398927.

18. Finkle J.D.*, Wu J.J.*, **Bagheri N.** A windowed Granger causal inference strategy improves discovery of gene regulatory networks. *Proc Natl Acad Sci USA* 115(9):2252–2257, 2018. PMID: 29440433.
17. Xue A.Y., Szymczak L.C., Mrksich M., **Bagheri N.** Machine learning on SAMDI mass spectrometry signal to noise ratio improves peptide array designs. *Anal Chem* 89(17):9039–9047, 2017. PMID: 28719743.
16. Hartfield R.M.*, Schwarz K.A.*, Muldoon J.J.*, **Bagheri N.**, Leonard J.N. Multiplexing engineered receptors for multiparametric evaluation of environmental ligands. *ACS Synth Biol* 6(11):2042–2055, 2017. PMID: 28771312.
15. Misharin A.V., Morales-Nebreda L., Reyfman P.A., Cuda C.M., Walter J.M., McQuattie-Pimentel A.C., Chen C.-I., Anekalla K.R., Joshi N., Williams K.J.N., Abdala-Valencia H., Yacoub T.J., Chi M., Chiu S., Gonzalez-Gonzalez F.J., Gates K., Lam A.P., Nicholson T.T., Homan P.J., Soberanes S., Dominguez S., Morgan V.K., Saber R., Shaffer A., Hinchcliff M., Marshall S.A., Bharat A., Berdnikovs S., Bhorade S.M., Bartom E.T., Morimoto R.I., Balch W.E., Sznajder J.I., Chandel N.S., Mutlu G.M., Jain M., Gottardi C.J., Singer B.D., Ridge K.M., **Bagheri N.**, Shilatifard A., **Budinger G.R.S.**, **Perلمان H.** Monocyte-derived alveolar macrophages drive lung fibrosis and persist in the lung over the lifespan. *J Exp Med* 214(8):2387–2404, 2017. PMID: 28694385.
14. Stainbrook S.C.*, Yu J.S.*, Reddick M.P., **Bagheri N.**, Tyo K.E.J. Modulating and evaluating receptor promiscuity through directed evolution and modeling. *Protein Eng Des Sel* 30(6):455–465, 2017. PMID: 28453776. [Undergraduate contribution from MPR.](#)
13. Yu J.S., Xue A.Y., Redei E.E., **Bagheri N.** A support vector machine model provides an accurate transcript-level-based diagnostic for major depressive disorder. *Transl Psychiatry* 6(10):e931, 2016. PMID: 27779627.
12. Yu J.S., **Bagheri N.** Multi-class and multi-scale models of complex biological phenomena. *Curr Opin Biotechnol* 6(10):e931, 2016. PMID: 27779627. [Invited review.](#) [Undergraduate contribution from JSY.](#)
11. Ciaccio M.F., Chen V.C., Jones R.B., **Bagheri N.** The DIONESUS algorithm provides scalable and accurate reconstruction of dynamic phosphoproteomic networks to reveal new drug targets. *Integr Biol* 7(7):776–791, 2015. PMID: 26057728. [Cover story.](#)
10. Duncan M.T.*, Shin S.*, Wu J.J.*, Mays Z., Weng S., **Bagheri N.**, Miller W.M., Shea L.D. Dynamic transcription factor activity profiles reveal key regulatory interactions during megakaryocytic and erythroid differentiation. *Biotechnol Bioeng* 111(10):2082–2094, 2014. PMID: 24853077.
9. Ciaccio M.F., Finkle J.D., Xue A.Y., **Bagheri N.** A systems approach to integrative biology: an overview of statistical methods to elucidate association and architecture. *Integr Comp Biol* 54(2):296–306, 2014. PMID: 24813462.
8. Han Q.*, **Bagheri N.***, Bradshaw E.M., Hafler D.A., Lauffenburger D.A., Love J.C. Polyfunctional responses by human T cells result from sequential release of cytokines. *Proc Natl Acad Sci USA* 109(5):1607–1612, 2012. PMID: 22160692.
7. **Bagheri N.**, Shiina M., Lauffenburger D.A., **Korn W.M.** A Dynamical Systems Model for Combinatorial Cancer Therapy Enhances Oncolytic Adenovirus Efficacy by MEK-inhibition. *PLoS Comput Biol* 7(2):e1001085, 2011. PMID: 21379332.
6. **Bagheri N.**, Stelling J., **Doyle III F.J.** Modeling the Drosophila melanogaster Circadian Oscillator via Phase Optimization. *J Biol Rhythms* 23(6):525–537, 2008. PMID: 19060261.
5. **Bagheri N.**, Stelling J., **Doyle III F.J.** Circadian phase resetting via Single and Multiple Control Targets. *PLoS Comput Biol* 4(7):e1000104, 2008. PMID: 18795146.
4. **Bagheri N.***, Taylor S.R.*, Meeker K., Petzold L.R., **Doyle III F.J.** Synchrony and Entrainment Properties of Robust Circadian Oscillators. *R Soc Interface* 5:S17–S28, 2008. PMID: 18426774.
3. **Bagheri N.**, Stelling J., **Doyle III F.J.** Circadian phase entrainment via nonlinear model predictive control. *Int J Robust Nonlin* 17:1555–1571, 2007.
2. **Bagheri N.**, Stelling J., **Doyle III F.J.** Quantitative performance metrics for robustness in circadian rhythms. *Bioinformatics* 23(3):358–364, 2007. PMID: 17158515.
1. **Doyle III F.J.**, Gunawan R., **Bagheri N.**, Mirsky H., To T.L. Circadian rhythm: A natural, robust, multi-scale control system. *Comput Chem Eng* 30:1700–1711, 2006.

BOOK CHAPTERS

4. **Bagheri N.**, Khammash M., Murray R. (2023) Engineering Biology. In: Annaswamy A. (eds) Control System Society Roadmap 2030.
3. Balakrishnan, N., **Bagheri, N.** (2023). Automatic Control in Systems Biology. In: Nof, S. (ed) Springer Handbook of Automation. Springer Handbooks. Springer, Cham. eBook ISBN 978-3-030-96729-1; Print ISBN 978-3-030-96728-4.
2. Yu J., **Bagheri N.** (2021) Agent-Based Modeling. In: Systems Medicine: Integrative, Qualitative and Computational Approaches (eds)
1. Mirsky H, Stelling J., Gunawan R., **Bagheri N.**, Taylor S., Kwai E., Shoemaker J, Doyle F.J. (2009) Automatic Control in Systems Biology. In: Nof S. (eds) Springer Handbook of Automation. Springer Handbooks. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-78831-7_75

LEADERSHIP, SERVICE & OUTREACH**AT THE UNIVERSITY**

- **Synthetic Biology Steering Committee, UW** 2022–
- **Goldwater Scholarship Review Committee, UW** 2022
- **Graduate Student and Postdoc Committee, UW Biology** 2021–2022
- **Faculty Search Committee, UW Biology** 2020–2021
- **Graduate Student and Postdoc Committee, UW Biology** 2019–2020
- **Founding Member, NSF-Simons Center for Quantitative Biology at Northwestern University** 2018
- **Founding Member, Center for Synthetic Biology at Northwestern University** 2017
- **Ad Hoc Reviewer, Northwestern University Clinical and Translational Sciences Institute TL1 applications** 2017
- **Faculty Search Committee, Northwestern University Chemical & Biological Engineering** 2015
- **Faculty Search Committee, Northwestern University Biomedical Engineering** 2015
- **Review Committee, Northwestern University Kellogg Scientists Executive Education** 2015
- **Faculty Search Committee, Northwestern University Molecular Biosciences** 2014
- **Graduate Student Admissions Committee, Northwestern University Interdisciplinary Biological Sciences Program** 2013

IN PROFESSIONAL SOCIETIES

- American Institute of Chemical Engineers (AIChE):
 - **Program vice chair** for Area 15D/E (Food, Pharmaceuticals, & Bioengineering) 2022
 - **Program vice chair elect** for Area 15D/E (Food, Pharmaceuticals, & Bioengineering) 2021
 - **Session chair/co-chair** annual
- Institute of Electrical and Electronic Engineers (IEEE):
 - **Technical Council on Life Sciences, Control Systems Society** 2019–
 - **Operations Co-Chair** for annual Conference on Decision and Control (CDC) (Miami, FL) 2018
 - **Technical Council on Systems Biology, Control Systems Society** 2017–2018
- Foundations of Systems Biology in Engineering (FOSBE):
 - **Conference Co-Chair** (Chicago, IL) 2018
 - **International Planning Committee** (Magdeburg, Germany) 2016
 - **Session Chair** (Boston, MA) 2015
- International Federation of Automatic Control (IFAC)
 - **Planning Committee, bid for 22nd World Congress** 2016
 - **Planning Committee, bid for 22nd World Congress** 2015
 - **Task Force, engagement of junior faculty** 2015

WITH GOVERNMENT AGENCIES

- **NSF Proposal Review Panels** ongoing
- **NSF Grand Challenge Workshop, Systems and Control Theory for Synthetic Biology** Nov 2021
- **AFOSR Grand Challenge Workshop, The Compositionality Problem in Synthetic Biology** Jun 2017
- **NSF Grand Challenge Workshop, Deciphering Genome to Phenome (G2P) Relationships** Oct 2015
- **NSF Grand Challenge Workshop, How Organisms Walk the Tightrope Between Stability and Change** Feb 2013

WITH THE ALLEN INSTITUTES

- **Allen Institute for Cell Science** International Workshop on Data Management (co-organizer) Sep 2022
- **Allen Institute for Cell Science** International Workshop on Data Generation (co-organizer) Sep 2022
- **NIH and Allen Institute for Cell Science** International Summit on Quantitative Cell Imaging (organizer) Oct 2021

FOR SCIENTIFIC JOURNALS

- **Current Opinion in Biotechnology** guest editor of special issue on "Systems Biology 2022" 2021–2022
- **Cell Systems** editorial board member 2020–
- **PLOS ONE** editorial board member 2018–
- **Processes**
 - Editorial board member 2018–2020
 - Guest editor, special issue on "Control of Disease States" 2018
 - Guest co-editor, special issue on "Biological Networks" 2017

FOR MENTORSHIP

- **Science Speaks Chicago.** Adler Planetarium Youth Council hosts a TED-style event that will bring attention to unheard and underrepresented voices of young adults in STEM fields in the Chicagoland area; Apr 2018.
- **Co-Producer of ETOPIA, the Engineering Transdisciplinary Outreach Project in the Arts**, an annual professional theater performance staged in McCormick School of Engineering and Applied Sciences to inspire cross-disciplinary dialogue about the role of science and technology in society. Performances are free and open to the public. 2015 performance: Bertolt Brecht's Galileo.
- **Faculty Fellow** for the Slivka (2014 – 2019), Chapin (2014-2017), and International (2012-2014) Student Residential Colleges.
- **Faculty Advisor** for American Institute of Chemical Engineers student chapter (2014-2019), Engineers in Science Policy (2017), and Code for Chicago (2015-2017).
- **Society of Women Engineers** (SWE) banquet keynote; May 2014.