

Justin Faber

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EDUCATION

PhD, Physics. University of California, Los Angeles (UCLA). August 2021

- Advisor: Dolores Bozovic, PhD
- Dissertation: *Chaos, Synchronization, and Signal Detection in Systems of Coupled Inner-Ear Hair Cells.*

BS, Engineering Physics. University of Illinois, Urbana-Champaign (UIUC). December 2013

- minor in Mathematics
- minor in Chemistry

RESEARCH EXPERIENCE

2014 - 2021 **Graduate Student Researcher in Physics, UCLA**
Developed Python libraries for simulation of high-dimensional, nonlinear dynamical models of the inner ear. Analyzed time-series experimental data from living inner-ear tissue during acoustic stimulus. Developed new theories to explain auditory detection using analytic and computational techniques.

2014 **Numerical Modeling Intern, John Deere US (Deere & Company)**
Developed simulation software in Python to model fluid flow through crop fields. Using rainfall and soil-moisture data, this model was validated and may be used for selecting optimal crop-planting locations.

2013 - 2014 **Undergraduate Student Researcher in Mathematics, UIUC**
Performed numerical simulations of Li-ion battery charging using the finite element method. Varied the configuration of the storage medium in order to minimize charging time and design maximally efficient batteries.

2013 - 2014 **Undergraduate Student Researcher in Aerospace Engineering, UIUC**
Designed and built a small rheometer to compress human tissue simulants and measure wave propagation in order to validate a viscoelastic model of the vocal folds. This model was used to understand the dynamics of human phonation.

OTHER COMPUTATIONAL PROJECTS

2020 - 2021 **Software Engineer, Grass Roots Neighbors (Nonprofit)**
Using Amazon Web Services (AWS) Lambda, we developed a text bot that runs on the AWS cloud in order to streamline communication between volunteer delivery drivers and food-insecure families requesting groceries.

2021 **Machine Learning Engineer in Physics, UCLA**
Created an EEG classification model, using support vector machines, that can distinguish between EEGs elicited from visual versus auditory stimuli with 90% accuracy when using only minimal data.

GRANTS, FELLOWSHIPS AND AWARDS

- 2014 - 2019 **Physics Division Fellowship**
Department of Physics & Astronomy, UCLA
- 2018 - 2019 **Richardson Fund Conference Support**
Department of Physics & Astronomy, UCLA
- 2017 **Outstanding Teaching Assistant Award**
Department of Physics & Astronomy, UCLA
- 2016 - 2017 **UCLA Doctoral Student Travel Grant**
Graduate Division, UCLA
- 2013 **NASA's Illinois Space Grant**
Undergraduate Research Opportunity, Aerospace Engineering, UIUC

TECHNICAL SKILLS

Programming: Python, MATLAB, Jupyter Notebooks, AWS Lambda, LaTeX, LabVIEW, signal processing, time series analysis, machine learning

Python Packages: NumPy, SciPy, Matplotlib, Pandas, Scikit-learn

Mathematics: nonlinear dynamics, chaos theory, bifurcation theory, combinatorics/probability, statistics

PEER-REVIEWED PUBLICATIONS

- [7] N. Senofsky, **J. Faber**, and D. Bozovic "Vestibular drop attacks and Meniere's disease as results of otolithic membrane damage – a numerical model" (under review). preprint: [arxiv:2107.01379](https://arxiv.org/abs/2107.01379)
- [6] **J. Faber** and D. Bozovic "Chimera states and frequency clustering in systems of coupled inner-ear hair cells" *Chaos*, 2021. doi.org/10.1063/5.0056848
- [5] **J. Faber**, H. Li, and D. Bozovic "Synchronization and chaos in systems of coupled inner-ear hair cells" *Physical Review Research*, 2021. doi.org/10.1103/PhysRevResearch.3.013266
- [4] Y. Roongthumskul, **J. Faber**, D. Bozovic "Dynamics of Mechanically Coupled Hair-Cell Bundles of the Inner Ear" *Biophysical Journal*, 2021. doi.org/10.1016/j.bpj.2020.11.2273
- [3] **J. Faber** and D. Bozovic "Chaotic dynamics enhance the sensitivity of inner ear hair cells" *Scientific Reports*, 2019. doi.org/10.1038/s41598-019-54952-y
- [2] **J. Faber** and D. Bozovic "Noise-induced chaos and signal detection by the nonisochronous Hopf oscillator" *Chaos*, 2019. doi.org/10.1063/1.5091938
- [1] **J. Faber** and D. Bozovic "Chaotic dynamics of inner ear hair cells" *Scientific Reports*, 2018. doi.org/10.1038/s41598-018-21538-z

Manuscripts in preparation

J. Faber and D. Bozovic "Robust Synchronization and Reliable Signal Detection by Coupled, Nonisochronous Hair Cells".

TALKS

- [3] **Chaotic dynamics enhance the sensitivity of inner-ear hair cells.** SIAM Conference on Application of Dynamical Systems, Snowbird, Utah. 2019.
- [2] **Chaotic dynamics of inner-ear hair cells.** American Physical Society March Meeting, Los Angeles, CA. 2018.
- [1] **Human speech: wave propagation in agarose gel.** NASA's Illinois Space Grant Consortium Undergraduate Research Opportunity Program Meeting, University of Illinois, Urbana-Champaign. 2013.

POSTER PRESENTATIONS

- [7] **Chaotic dynamics enhance the sensitivity of inner-ear hair cells.** Association for Research in Otolaryngology Midwinter Meeting, Baltimore, MD. 2019.
- [6] **Chaotic dynamics of inner-ear hair cells.** Association for Research in Otolaryngology Midwinter Meeting, San Diego, CA. 2018.
- [5] **Chaotic dynamics of inner-ear hair cells.** Biophysical Society Annual Meeting, New Orleans, LA. 2017.
- [4] **Chaotic behavior of oscillatory hair cells.** Biophysical Society Annual Meeting, Los Angeles, CA. 2016.
- [3] **Chaotic behavior of oscillatory hair cells.** USACM Thematic Conference on Multiscale Methods and Validation in Medicine and Biology, Los Angeles, CA. 2016.
- [2] **Lithium-ion batteries: structure and efficiency.** Illinois Geometry Lab Open House, University of Illinois, Urbana-Champaign. 2014.
- [1] **Lithium-ion batteries: structure and efficiency.** Illinois Geometry Lab Open House, University of Illinois, Urbana-Champaign. 2013.

TEACHING EXPERIENCE

- 2014 - 2017 **Teaching Assistant, Department of Physics & Astronomy, UCLA**
Courses: Classical Mechanics for Engineers, Classical Mechanics for Life Science Majors, Electricity & Magnetism for Engineers, Oscillations, Waves & Optics for Life Science Majors, Polymer Physics
- 2013 **Teaching Assistant, Department of Engineering, Physics, UIUC**
Courses: Modern Experimental Physics (upper-division lab course)

PUBLIC SERVICE & OUTREACH

- 2020 - present **Volunteer at Grass Roots Neighbors (Nonprofit), Los Angeles, CA**
Distribute hot meals by bicycle every Sunday night to the unhoused people living in Venice, Los Angeles. Repair bicycles as needed. Developed a text bot to run on the AWS cloud and streamline communication between volunteer delivery drivers and food-insecure families requesting groceries.

2013 - 2014

Outreach Volunteer with Illinois Geometry Lab, UIUC

Performed experiments and demonstrations involving physics and mathematics to groups of local elementary students with the hope of sparking their interest in STEM.