Brian L. Frost, Ph.D.

bfrost@rockefeller.edu +1 (516) 712-9784

Education

Sep 2019 – Nov 2023 | **Ph.D. in Electrical Engineering**
Columbia University
Secondary concentration in physics

Sep 2019 – Feb 2021 | **M.S. in Electrical Engineering**
Columbia University

Sep 2015 – May 2019 | **B.E. in Electrical Engineering**
The Cooper Union, summa cum laude
Minor in mathematics

Teaching Experience

Sep 2019 - Ongoing | **Adjunct Professor**
New York University
- Teaching a course in the Mathematics Department
  - *Probability , Fall 2025 (projected)*

Adjunct Professor
The Cooper Union
- Taught undergraduate courses in the Electrical Engineering Department
  - *Circuit Analysis, Fall 2019*: 30 students
  - *Communication Theory, Fall 2020*: 19 students
- Designed and taught a graduate-level Electrical Engineering elective on the device physics and processing techniques used in medical imaging
  - *Medical Imaging, 2021-2025*: 43 students total
- Taught undergraduate courses in the Mathematics Department
  - *Probability, 2020-2022*: 63 students total
  - *Ordinary Differential Equations, 2022-2025*: 296 students total
  - *Vector Calculus, Fall 2025 (projected)*
- Guided independent studies related to image processing and theoretical neuroscience
  - *CT Medical Image Project, Fall 2024*: Graduate-level independent study for one student
  - *Theoretical Neuroscience, Spring 2025*: Graduate-level independent study for one student

Sep 2021 - May 2022 | **Teaching Assistant**
Columbia University – Graduate School of Arts and Sciences
- Held office hours and graded homeworks, exams, projects and presentations for two graduate-level Electrical Engineering courses
  - *Optical Systems, Fall 2021*: Professor Christine P. Hendon, Ph.D.
  - *Digital Signal Processing, Spring 2022*: Professor John Wright, Ph.D.

Sep 2017 - Jun 2019

Undergraduate Instruction and Tutoring

The Cooper Union

- Worked as a MATLAB instructor for a sophomore-level Electrical Engineering course in Signals and Systems, which involved giving lectures, designing and grading homework assignments and holding office hours
- Worked as a tutor for the Mathematics Department, offering tutoring services to undergraduate students in many topics including calculus, probability, differential equations, linear algebra and complex analysis

Research Experience

Mar 2024 - Ongoing

Postdoctoral Scientist

The Rockefeller University, Howard Hughes Medical Institute

- Worked at the Laboratory of Sensory Neuroscience under the advisement of Kavli Prize laureate A. James Hudspeth, M.D., Ph.D.
- Designed and performed experiments for studying the mechanics of the cochlea *in vivo* and *in vitro* in tokay gecko, mouse and gerbil models
- Investigated spontaneous otoacoustic emissions and sound-evoked displacement responses in the tokay gecko and OtoA$^{-/-}$ mutant mice using optical coherence tomography (OCT)
- Investigated gross mechanical properties of the gerbil organ of Corti subject to chemical insult using OCT
- Developed mathematical methods for analyzing OCT-measured vibration patterns in the organ of Corti based in volume processing and differential geometry (*publication in progress*)
- Developed geometric methods for quantifying the mechanisms of morphological rotations during hair cell fate determination in the zebrafish lateral line (*publication in progress*)

Sep 2019 - Feb 2024

Doctorate Student

Columbia University

- Worked at the Structure Function Imaging Lab under the advisement of OCT expert Christine P. Hendon, Ph.D. (Department of Electrical Engineering)
- Worked at the Fowler Lab at Columbia University Irving Medical Center under co-advisor Elizabeth S. Olson, Ph.D. (Departments of Biomedical Engineering and Otolaryngology)
- Studied the application of OCT to measuring vibrations within the cochlea
- Designed and performed *in vivo* cochlear mechanics experiments in gerbil and guinea pig animal models (*See publications 1, 2, 3, 6, 8, 9*)
- Developed unique analysis methods for the interpretation of multi-dimensional time-series data acquired using OCT (*See publications 1, 2, 3, 5, 6, 8, 9*)
- Developed a model of the electrodynamics of the cochlea, solved by the finite element method (*See publication 11*)
- Wrote a tutorial article to teach other hearing scientists about the Wentzel-Kramers-Brillouin method of mathematical modeling for cochlear mechanics (*See publication 4*)
- Collaborated with New York University's Nikola Janjušević, Ph.D., to develop a compressed sensing method for accelerating OCT displacement measurements over large volumes (*See publication 8*)

Sep 2015 - Jun 2019

Undergraduate Research

The Cooper Union, Oregon State University

- Worked with Cooper Union's Stanislav Mintchev, Ph.D. to investigate the network-level effects of axonal swelling – a result of traumatic brain injury (*See publication 7*)
- Participated in an undergraduate mathematics research program at Oregon State University, where I developed a model for communication between cells in a chemical gradient under the advisement of Juan Restrepo, Ph.D. and Dallas Foster, Ph.D. (*See publication 10*)

Publications

2025

1. **Frost, B.**, Stribu, C. E. & Olson, E. S. Narrow Elliptical Motion at the Outer Hair Cell-Deiters' Cell Junction Explains Disparate Features of Uniaxial Displacement Measurements. *Hearing Research (in press)* (2025)

2. Olson, E. S., Dong, W., Applegate, B. E., Charaziak, K. K., Dewey, J. B., **Frost, B.**, Meenderink, S. W., Nam, J.-H., Oghalai, J. S., Puria, S., Ren, T., Strimbu, C. E. & van der Heijden, M. Visualizing motions within the cochlea's organ of Corti and illuminating cochlear mechanics with optical coherence tomography. *Hearing Research* (2025)

2024

3. **Frost, B.** Optical Coherence Tomography Techniques for Contextualizing and Reconstructing Displacement Responses in the Mammalian Cochlea. *Doctoral Thesis - Columbia University* (2024)

4. **Frost, B.** Foundations of the Wentzel-Kramers-Brillouin approximation for models of cochlear mechanics in 1- and 2-D. *Journal of the Acoustical Society of America* **155,** 358–379 (2024)

5. Strimbu, C. E., Chiriboga, L. A., **Frost, B.** & Olson, E. S. Regional differences in cochlear nonlinearity across the basal organ of Corti of gerbil. *Hearing Research* **443,** 108951 (2024)

2023

6. **Frost, B.**, Strimbu, C. E. & Olson, E. S. Reconstruction of transverse-longitudinal vibrations in the organ of Corti complex via optical coherence tomography. *Journal of the Acoustical Society of America* **153,** 1347–1360 (2023)

7. **Frost, B.** & Mintchev, S. A high-efficiency model indicating the role of inhibition in the resilience of neuronal networks to damage resulting from traumatic injury. *Journal of Computational Neuroscience* **51,** 463–474 (2023)

8. **Frost, B.**, Janjušević, N. P., Strimbu, C. E. & Hendon, C. P. Compressed sensing on displacement signals measured with optical coherence tomography. *Biomedical Optics Express* **14,** 5539–5554 (2023)

2022

9. **Frost, B.**, Strimbu, C. E. & Olson, E. S. Using volumetric optical coherence tomography to achieve spatially resolved organ of Corti vibration measurements. *Journal of the Acoustical Society of America* **151,** 1115–1125 (2022)

2021

10. Foster, D., **Frost, B.**, Victor, C. & Restrepo, J. Gradient sensing via cell communication. *Physics Review E* **103,** 022139 (2021)

11. **Frost, B.** & Olson, E. S. Model of cochlear microphonic offers insight into the tuning and magnitude of hair cell transduction current. *Biophysical Journal* **120,** 3550–3565 (2021)

Conference Abstracts

2024

1. **Frost, B.**, Strimbu, C. E. & Olson, E. S. High-Frequency Structure of Displacement Responses at the Junction Between Outer Hair Cells and Deiters Cells Suggests Lineal Motion Patterns. *Correspondences of the Mechanics of Hearing 2024 Meeting* (2024)

2. Chiriboga, L., Strimbu, C. E., **Frost, B.** & Olson, E. S. Beyond the Outer Tunnel: Comparisons Across Radial Regions of the Organ of Corti in the Guinea Pig Base. *Correspondences of the Mechanics of Hearing 2024 Meeting* (2024)

3. **Frost, B.**, Janjušević, N. P., Strimbu, C. E. & Hendon, C. P. Improving Resolution of OCT Vibrometry in the Cochlea With Compressed Sensing. *Abstracts of the 47th midwinter research meeting, Association for Research in Otolaryngology* (2024)

4. Chiriboga, L., Strimbu, C. E., **Frost, B.** & Olson, E. S. Intracochlear Motion Measurement in the Basal Turn of the Guinea Pig Cochlea: A Comparison Across Species and Cochlear Locations. *Abstracts of the 47th midwinter research meeting, Association for Research in Otolaryngology* (2024)

5. Olson, E. S., Strimbu, C. E., Chiriboga, L. & **Frost, B.** Intracochlear Motion Measurement in the Basal Turn of the Guinea Pig Cochlea: A Comparison Across Species and Cochlear Locations. *Abstracts of the 47th midwinter research meeting, Association for Research in Otolaryngology* (2024)

6. **Frost, B.**, Janjušević, N. P., Strimbu, C. E. & Hendon, C. P. Compressed Sensing on Displacement Signals Measured with Optical Coherence Tomography. *Abstracts of SPIE Photonics West* (2024)

2023

7. **Frost, B.** & Mintchev, S. Mechanisms for Recovery in Integrate-and-Fire Networks Impacted by Axonal Swelling. *Abstracts of the 2023 SIAM Conference on Dynamical Systems* (2023)

8. Chiriboga, L., **Frost, B.**, Strimbu, C. E. & Olson, E. S. Designing a Coupled Common-Mode OCT Probe with a Voltage Electrode for Simultaneous Intracochlear Motion and Voltage Measurements in Guinea Pig. *Abstracts of the 46th midwinter research meeting, Association for Research in Otolaryngology* (2023)

2022

9. **Frost, B.**, Strimbu, C. E. & Olson, E. S. Using Volumetric Optical Coherence Tomography to Achieve Spatially Resolved Organ of Corti Vibration Measurements. *Abstracts of the 45th midwinter research meeting, Association for Research in Otolaryngology* (2022)

10. **Frost, B.**, Strimbu, C. E. & Olson, E. S. Transverse-Longitudinal Structure Registration and Vibration Measurement via Optical Coherence Tomography. *Correspondences of the Mechanics of Hearing 2022 Meeting* (2022)

2021

11. **Frost, B.** & Olson, E. S. Cochlear Microphonic Measurements Indicate Sharper Tuning at Stereocilia Than at Basilar Membrane. *Abstracts of the 44th midwinter research meeting, Association for Research in Otolaryngology* (2021)

2019

12. **Frost, B.** & Mintchev, S. Spiking Activity in Networks of Neurons Impacted by Axonal Swelling. *Abstracts of the 2019 Biology and Medicine Through Mathematics Conference* (2019)

Grants and Awards

2024

1. Winner of the 2024 Columbia University Electrical Engineering Collaborative Research Award

2022

2. F-31 Grant from the National Institute of Deafness and Other Communications Disorders: *Reconstruction of three-dimensional organ of Corti micromechanical motion patterns via optical coherence tomography*

3. Winner of an ARO 2022 Midwinter Meeting Travel Award

4. Winner of an MOH 2022 Travel Award