Connor McCullough, PhD

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EDUCATION

PhD in Bioengineering August 2016 – December 2022
University of Colorado Anschutz Medical Campus, Aurora CO, USA
Outstanding Graduate Student, Department of Bioengineering
Outstanding Graduate Student, College of Engineering, Design and Computing

Bachelor of Science in Physics August 2011 – August 2015
University of Florida, Gainesville FL, USA

CURRENT RESEARCH

Development of miniaturized fiber coupled microscopes and neural implants for recording and modulating neural activity in vivo using multielectrode arrays, two-photon imaging, and holographically patterned optogenetic stimulation

WORK EXPERIENCE

Postdoctoral Fellow January 2023 - Current
U. of Colorado Anschutz Medical Campus, Dept. of Bioengineering, Aurora CO, USA
- One of three lead engineers on a multi-group collaborative project leading to design, fabrication, characterization, and demonstration of a first of its kind miniature fiber coupled microscope providing microelectromechanical systems (MEMS) mirror scanner based two-photon calcium imaging and spatial light modulator (SLM) generated holographic optogenetic stimulation in freely moving mice, affordably constructed from off the shelf optics
- Lead engineer on a collaborative project with an electrical engineering group developing a neural implant that combines transparent multielectrode arrays and gradient index lenses for simultaneous electrophysiology and two-photon imaging/optogenetics in overlapping neuronal populations

Graduate Student Researcher August 2016 – December 2022
U. of Colorado Anschutz Medical Campus, Dept. of Bioengineering, Aurora CO, USA
- Collaborated with neuroscientists, optical engineers, and machinists to develop a neural implant which combined gradient index (GRIN) lenses and tetrodes for two-photon calcium imaging and electrophysiology in overlapping neuronal populations, capable of recording from freely moving mice by optically coupling through a coherent imaging fiber bundle
- Wrote MATLAB finite element analysis code & GUI for simulation of electrowetting lenses for adaptive optics application

TECHNICAL SKILLS

Optics: Optical alignment, characterization, and optimization, optomechanics, adaptive optics, fiber optics, ultrafast pulsed lasers, multiphoton microscopy, nonlinear optics, 2D and 3D imaging
Software/Programming: Zemax, SolidWorks, Python, MATLAB, LabVIEW, C++, Git, Arduino for hardware control, National Instruments acquisition systems, Microsoft Office Suite
Data Analysis: MATLAB/Python analysis (cross-correlation, generalized linear models, etc.) and plotting, high-quality figure/video generation in Adobe Illustrator/InkScape/Adobe Premiere
Prototyping: CAD design, 3D printing, machining, laser cutting

SELECTED COURSES

Intro to Quantum Mechanics I, First Order Optical Design, Optical Efficiency and Resolution, Design of High-Performance Optical Systems, Advanced MATLAB, Analytic/Numerical Methods for Engineering Analysis

SELECTED PUBLICATIONS

• **McCullough CM**, Ramirez-Gordillo D, Hall M, Futia GL, Moran AK, Gibson EA, Restrepo D. GRINtrode: a neural implant for simultaneous two-photon imaging and extracellular electrophysiology in freely moving animals. Neurophotonics. October 2022. doi: 10.1117/1.NPh.9.4.045009
• Ozbay BN, Futia GL, Ma M, **McCullough CM**, Young MD, Restrepo D, Gibson EA. Miniature Multiphoton Microscopes for Recording Neural Activity in Freely Moving Animals. All-Optical Methods to Study Neuronal Function. February 2023. doi: 10.1007/978-1-0716-2764-8_7
• Zohrabi M, Cormack RH, **McCullough CM**, Supekar OD, Gibson EA, Bright VM, Gopinath JT. Numerical analysis of wavefront aberration correction using multielectrode electrowetting-based devices. Optics Express. December 2017. doi: 10.1364/OE.25.031451

PATENTS

• Methods and systems for imaging with aberration correction, U.S. Patent No. 11933973. 19 Mar. 2024.