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Imperial College London Department of Bioengineering
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Academic Training

2012	PhD, with distinction	Yale University	Neuroscience, Supervisor Prof David McCormick
2010	MPhil	Yale University	Neuroscience, Supervisor Prof David McCormick
2006	BSc, summa cum laude	Washington State University	Neuroscience emphasis EE, computation

Current Position

Lecturer (July 2018-present) Department of Bioengineering, Imperial College London
Royal Academy of Engineering Research Fellow (2016-present)

Previous Professional Experience

2015 Postdoctoral Fellow: PI: Simon Schultz, DPhil.: Imperial College London, London, UK.
2013-2014 Postdoctoral Fellow; PI: Valentina Emiliani, Ph.D.: Université Paris Descartes, Paris, France.
2012 Visiting scientist; *Super-resolution voltage-sensitive dye imaging*; Hell Laboratory; Max Planck Göttingen, Germany.
2008-2012 Ph.D. Candidate; *Optically Tracking Action Potential Initiation and Propagation in CNS Neuron Axonal Arbors with Voltage-Sensitive Dyes;* PI: David McCormick, Ph.D.: Yale University, New Haven, CT.
2007-2008 Graduate Rotation Student; *Implantable optical probes for two-photon imaging of deep brain structures*; PI: Michael Levene, Ph.D.; Yale University, New Haven, CT.
2005 Research Technician; Artificial Retina Program; PI: John S. George, Ph.D.; Los Alamos National Laboratory, Los Alamos, NM.
2003-2007 Research Assistant; *Intrinsic Optical Neurophysiology*; PI: David M. Rector, Ph.D.; Washington State University, Pullman, WA.

Professional Memberships

The Optical Society (OSA)
Institute of Electrical and Electronics Engineers (IEEE)

Refereed Publications

21. Quicke, P.; Howe, C.L.; Song, P.; Verinaz Jadan, H.; Song, C.; Knöpfel, T.; Neil, M.; Dragotti, P. L.; Schultz, S. R.; **Foust, A. J.**, 2020. Subcellular resolution 3D light field imaging with genetically encoded voltage indicators; Neurophotonics 7(3) 035006. DOI: 10.1117/1.NPh.7.3.035006.
20. Song, P.; Jadan, H.V.; Howe, C.L.; Quick, P.; **Foust, A.J**., Dragotti, P.L.; 2020. 3D localization for light-field microscopy via convolutional sparse coding on epipolar images; IEEE Trans Comp Imag 6:1017-1032. DOI: 10.1109/TCI.2020.2997301.
19. Quicke, P.; Song, C.; McKimm, E.J.; Milosevic, M.M.; Howe, C.L.; Neil, M.; Schultz, S.R.; Antic, S.D.; **Foust, A.J.;** Knöpfel, T., 2019. Single-Neuron Level One-Photon Voltage Imaging With Sparsely Targeted Genetically Encoded Voltage Indicators. Front Cell Neurosci 13(39):1-12. DOI: 10.3389/fncel.2019.00039.
18. Soor, J.; Quicke, P.; Howe, C.L.; Pang, K.T.; Neil, M.A.A.; Schultz, S.R.; **Foust, A.J.**, 2019. All-Optical Crosstalk-Free Manipulation and Readout of Chronos-expressing Neurons. J Phys D. 52(10): 104002. DOI: doi.org/10.1088/1361-6463/aaf944.
17. Quicke, P.; Reynolds, S.; Neil, M.; Knöpfel, T.; Schultz, S.R.; **Foust, A.J.**. 2018. High speed functional imaging with Source Localized Multifocal Two-Photon Microscopy. Biomed Opt Exp 9(8):3678-3693. DOI: 10.1364/BOE.9.003678. PMCID: PMC6191622.
16. Cazé, R. ; Jarvis, S. ; **Foust, A.J.** ; Schultz, S.R. 2017. Dendrites enable a robust mechanism for neuronal stimulus selectivity. Neural Comput. 29(9):2511-2527. DOI: 10.1162/NECO_a_00989.
15. Guillon, M.; Forget, B. C.; **Foust, A. J.**; de Sars, V.; Ritsch-Marte, M.; Emiliani, V. 2017. Vortex-free phase profiles for uniform patterning with computer-generated holography. Optics Express 25(11):12640-12652. DOI: 10.1364/OE.25.012640.
14. Ronzitti, E.; Conti, R.; Papagiakoumou, E.; Tanese, D.; Zampini, V.; Chaigneau, E.; **Foust, A. J.;** Klapoetke, N.; Boyden, E. S.; Emiliani, V., 2017. Sub-millisecond optogenetic control of neuronal firing with two-photon holographic photoactivation of Chronos. J Neurosci. 37(44):10679-10689. DOI: 10.1523/JNEUROSCI.1246-17.2017.
13. Schultz, S. R., Copeland, C. S., **Foust, A. J.,** Quicke, P., Schuck R., 2017. Advances in two photon scanning and scanless microscopy technologies for functional neural circuit imaging. Proc IEEE 105(1):139-157. DOI: 10.1109/JPROC.2016.2577380.
12. Casale, A. E., **Foust, A. J.,** Bal, T., McCormick, D. A., 2015. Cortical interneuron subtypes vary in their axonal action potential properties. J Neurosci 35(47):15555-15567. DOI: https://doi.org/10.1523/JNEUROSCI.1467-13.2015.
11. **Foust, A. J.,** Zampini, V., Tanese, D., Papagiakoumou, E., Emiliani, V., 2015. Computer generated holography enhances voltage dye fluorescence discrimination in adjacent neuronal structures. Neurophotonics 2(2):021007. DOI: 10.1117/1.NPh.2.2.021007.
10. **Foust, A. J.,** Popovic, M., Zecevic, D., McCormick, D. A., 2011. Somatic Membrane Potential and Kv1 Channels Control Spike Repolarization in Cortical Axon Collaterals and Presynaptic Boutons. J Neurosci 31(43):15490-15498. DOI: 10.1523/JNEUROSCI.2752-11.2011.

9. Popovic, M., **Foust, A. J.,** McCormick, D. A., Zecevic, D., 2011. Spatial profile of membrane potential changes during action potential initiation and propagation in axons of layer 5 cortical pyramidal neurons. Journal of Physiology. 589(17):4167–4187.
8. **Foust, A.,** Popovic, M., Zecevic, D., McCormick, D.A., May 2010. Action potentials initiate in the axon initial segment and propagate through axon collaterals reliably in cerebellar Purkinje neurons. Journal of Neuroscience 30(20),6891-902. DOI: 10.1523/JNEUROSCI.0552-10.2010.
7. Schei, J. L., **Foust, A. J.,** Rojas, M. J., Navas, J. A., Rector, D. M., April 2009. State-dependent auditory evoked hemodynamic responses recorded optically with indwelling photodiodes. Applied Optics 48 (10). DOI: 10.1364/AO.48.00D121.
6. Schei, J. L., McCluskey, M. D., **Foust, A. J.,** Yao, X. C., Rector, D. M., April 2008. Action potential propagation imaged with high temporal resolution near-infrared video microscopy and polarized light. NeuroImage 40 (3), 1034–1043. DOI: 10.1016/j.neuroimage.2007.12.055.
5. **Foust, A. J.,** Schei, J. L., Rojas, M. J., Rector, D. M., 2008. In vitro and in vivo noise analysis for optical neural recording. Journal of Biomedical Optics 13 (4). DOI: 10.1117/1.2952295.
4. McCluskey, M. D., Sable, J. J., **Foust, A. J.,** Gratton, G., Rector, D. M., April 2007. Recording invertebrate nerve activation with modulated light changes. Applied Optics 46 (10), 1866–1871. DOI: 10.1364/AO.46.001866.
3. **Foust, A. J.,** Rector, D. M., March 2007. Optically teasing apart neural swelling and depolarization. Neuroscience 145 (3), 887–899. DOI: 10.1016/j.neuroscience.2006.12.068.
2. Yao, X. C., **Foust, A.,** Rector, D. M., Barrowes, B., George, J. S., June 2005. Cross-polarized reflected light measurement of fast optical responses associated with neural activation. Biophysical Journal 88 (6), 4170–4177. DOI: 10.1529/biophysj.104.052506.
1. **Foust, A. J.,** Beiu, R. M., Rector, D. M., April 2005. Optimized birefringence changes during isolated nerve activation. Applied optics 44 (11), 2008–2012. DOI: 10.1364/AO.44.002008.

Research Description

Amanda J Foust is a Lecturer in the Department of Bioengineering at Imperial College London. She began optical neurotechnology research early as a student at Washington State University. Mentored by Prof. David Rector, Amanda pioneered improvements to systems and analyses for imaging the intrinsic optical correlates of action potential propagation. From these studies Amanda published seven peer-reviewed articles while completing a rigorous interdisciplinary curriculum in neuroscience, physics, electrical engineering, computer science, and mathematics. Amanda then completed MPhil and PhD degrees at Yale University supervised by David McCormick, adapting and applying recent advances in voltage-sensitive dye microscopy to discover how action potentials propagate through cortical neuron axons with high fidelity. She then won a NSF International Research Fellowship to study Fourier optics with Prof. Valentina Emiliani in Paris, France. Amanda optimized holographic light-shaping technology to demonstrate, for the first time, that sculpting light directly onto structures of interest can enhance the spatial specificity and signal-to-noise of functional fluorescence recordings. Amanda then co-wrote a funding bid to the US NIH B.R.A.I.N. Initiative to establish a consortium between Prof. Emiliani's laboratory and three others, including Prof. Simon Schultz's, to adapt and optimize holographic light shaping for neuronal applications in-vitro and in-vivo. She holds a five-year Research Fellowship from the Royal Academy of Engineering.

The aim of my research programme is to engineer bridges between cutting-edge optical technologies and neuroscientists to acquire new, ground-breaking data on how brain circuits wire, process, and store information.

Research Contracts

2021-2026. *Three Photon Microscopy Suite*. Wellcome Trust, Schultz (PI), Foust, Rowlands, Stevens, Lloyd, Lo Celso, Vermot £510,071 (Co-I).

2020. *Imaging membrane voltage light fields: new views into the pathophysiology of cancer*. Integrated Biological Imaging Network Pump-prime. £25,000 (PI).

2018-2020. *Instrument for characterizing two-photon absorption and action spectra of red and near-infrared fluorophores and membrane conductance actuators.* EPSRC Capital Award for Early Career Researchers. £88,000 (subproject PI).

2018-2021. *Two-photon Light Field with Neuro-active Sensing for Fast Volumetric Neural Microcircuit Readout.* BBSRC £807,000 (PI).

2016. AMS/Wellcome Daniel Turnberg Travel Fellowship. Visiting Scientist to Weizmann Institute. £3,100.

2016-18. *Holographic Induction of Neural Circuit Plasticity.* Wellcome Trust Seed Award. £100,000 (PI)

2016-21. *Holographic Light Shaping for Reverse Engineering Neural Circuit Learning.* Royal Academy of Engineering Research Fellowship, £525,000. (Research Fellow)

2015-18. *Three dimensional holography for parallel multi-target optogenetic circuit manipulation*. NIH 1U01NS090501-01. US$ 1.25M. [IC £217,918] S Picaud et al. (Co-I)

2013-14. *Scanless Two-Photon Voltage Imaging of Live Neuron Activity with Holographic Wavefront Shaping.* National Science Foundation International Postdoctoral Research Fellowship. US $141,700. (Post-doctoral Fellow)

2012. Whitaker Foundation Postdoctoral Fellowship (declined)

2010-12. *Optical Imaging of Information Processing in CNS Axons*. NIH/NINDS NRSA F31 NS 070368-01. US $83,180. (PI)

2007–10. National Science Foundation Graduate Research Fellowship. US $90,000. (Pre-doctoral Fellow)

Service

Reviewer for Journals: Cell Reports, Biophysical Journal, SPIE Neurophotonics, Optica, Biomedical Optics Express

Reviewer for funding agencies: HFSP, BBSRC, Wellcome

Co-organizer of Rank Prize Meeting "Seeing through Obscuration", Grasmere, England (virtual, July 2020)

Mental Health First Aider (2019-)

Imperial Bioengineering Safety Committee, Department Laser Safety Officer (2018-)

Mock Interview for Imperial Bioengineering fellowship interviewees (November 2018)
Imperial Bioengineering Interview panel for UG study abroad (December 2018)
BioMedEng18 Biomedical Imaging session chair (September 2018)
NeuroFrance 2017 Symposium Chair, "Optically enlightening synaptic integration models." Bordeaux (May 2017)
Neuroscience Outreach at Yale co-founder/coordinator (2010-2012)
Washington State University (WSU) Neuroscience Club President (2005-2006)
Kid's Judge! Science Fair Exhibitor/Volunteer (2004-2007)

Research Supervision

Post-doctoral trainees:

Dr. Carmel Howe (2018-present)

Dr. Pingfan Song (2018-present; 50% supervision with Prof. Pier Luigi Dragotti)

Dr. Peter Quicke (2020)

Doctoral trainees:

Navjeevan Soor (October 2016-present), EPSRC Neurotechnology 3+1 CDT, *Co-supervisor*.
Co-supervisors: Prof. Simon Schultz (primary), Prof. Stephen Brickley (Life Sciences), Prof. Mark Neil (Physics).

Noah Telerman (October 2020-present), Bioengineering start-up funding, *Primary supervisor.*
Co-supervisor: Prof Simon Schultz

MSc Bioengineering:

Jingyi Yang, Alison Sanders (2020)

Doctoral candidate mentees (Primary Supervisor: Prof. Simon Schultz):

Peter Quicke (EPSRC Neurotechnology, 2015-2019)
Renaud Schuck (Marie Curie Predoctoral Fellow, 2015-2017)

Undergraduate Teaching

2019, 2020: Electrical Engineering I, sub-module leader
2006: Neurophysiology (NEURO 499, WSU): Delivered a 2-hour lecture and assisted weekly laboratory sessions

Postgraduate Teaching

2015, 2016, 2018: Neurotechnology Optical Imaging Techniques (Imperial, MSc/MRes), development and delivery of 2 hr lecture + 3 hr laboratory on two-photon imaging.
2016, 2018: Neuroscience (BE9-MINS), development and delivery of 1 hr lecture on optical methods for neuro
2015: Design, Make, Test (ME3 DMT) co-supervisor. Guided a group of students to define a mechanical problem on my microscope system and to test the position and vibrational performance of the solution they developed.
2014: Monabiphot course (Masters in Molecular nano- and bio-photonics, Université Paris Descartes, 2014), developed and delivered lecture
2009: Ethics in Neuroscience (Yale, Teaching Fellow), course organization/marking
2010: Neuroanatomy (Yale, Teaching Fellow), ran anatomical laboratory tutorial group

Academic and Professional Honors

2012 Doctoral dissertation approved with distinction, Yale University
2011 Selected US delegate to the Lindau Meeting of Nobel Laureates, Germany
2011 Marine Biological Laboratory "Theoretical Neuroscience" summer course (competitive entry, Wood's Hole)
2006 Faculty for Undergraduate Neuroscience *Society for Neuroscience* Travel Award
2006 Washington State University (WSU) Faculty Association for Scholarship and Research Undergraduate Research Award
2006 WSU Honors College Thesis Pass with Distinction
2004 WSU Center for Integrated Biotechnology Undergraduate Summer Research Fellowship
2002-2006 WSU Distinguished Regents Scholar (full scholarship and stipend)

Invited Lectures

14. "Horizons for Reverse Engineering Neuronal Networks in Living Brains," Horizons of Optics, Photonics and Emerging Sciences (HOPES) Webinar Series, IEEE UK and Ireland Photonics Chapter; November 2020.
13. "Light Field Cellular Resolution Mammalian Neurophysiology," OSA Biophotonics Congress: Biomedical Optics, Optics and the Brain; Fort Lauderdale, FL (remotely); April 2020.
12. "Negotiating the photon budget for neuronal membrane potential imaging"; Imperial Centre for Neurotechnology Seminar; London, United Kingdom; January 2019.
11. "Overcoming spectral crosstalk for all-optical neuronal manipulation and readout"; Optogen 2018; Glasgow, Scotland; December 2018.
10. "Recording and manipulating neural activity with holographically sculpted light"; EMEA Broadcom Workshop 2018 on Brain-inspired Technologies; London, United Kingdom; October 2018.
9. "Avoiding spectral crosstalk (and when not to FRET it)"; 45th+1 Anniversary Celebration of Merocyanine 540; Wood's Hole, Massachusetts, USA; August 2018.
8. "Resolving fast neuronal impulses in scattering brain tissue"; Light transport and imaging through complex media; Royal Society, Chicheley Hall, United Kingdom; January 2018.
7. "Combining optogenetics with holograms to crack the neural code"; Barts Health/QMUL; London, United Kingdom; April 2016.
6. "Speeding up Neural Circuit Manipulation and Readout With Computer-generated Holography"; Photonex London; United Kingdom; April 2016.

5. “Spots, blobs, and sheets: New technologies for imaging and manipulating membrane potential”; Dendritic Sophistication: From Structure to Function; European Institute for Theoretical Neuroscience; Paris, France; March 2016.
4. “Holographic Light Sculpting for Fast, Parallel, and Spatially Precise Neural Microcircuit Investigation”; NETT International Conference on System Level Approaches to Neural Engineering; Barcelona, Spain; September 2015.
3. “Voltage dyes enable direct characterization of action potential generation, fidelity, and kinetics in CNS axonal arbors”; 40th Anniversary Celebration of Merocyanine 540; Wood's Hole, Massachusetts, USA; August 2013.
2. “Teasing apart biophysical underpinnings of CNS axon spike kinetics”; International Union of Physiological Sciences Meeting, Birmingham UK, May 2013.
1. “The fate of action potentials in axons: clues from voltage imaging”; Faculté de Médecine secteur Nord; Marseille, France, May 2013.

Relevant Training and Expertise

Neuroscience

Coursework (WSU, Yale) :

Methods in Computational Neuroscience, Woods Hole, MA (August 2011)
Comparative and Human Neuroanatomy (Teaching Fellow, Yale University School of Medicine, Spring 2011)
Neurophysiology (Teaching Assistant, Washington State University, Spring 2006)
Neurobiology
Sensory Neurophysiology
Visual/Motor Neurophysiology

Mathematics

Coursework (WSU):

Calculus, Linear Algebra, Discrete Mathematics, Differential Equations, Applied Probability

Electrical Engineering

Coursework (WSU):

Analog Circuits, Logic Circuits, Digital Design

Software Engineering

Coursework (WSU):

Software Design and Implementation (C, C++)
Languages: Octave/Matlab, Python, C++, C, VHDL (FPGAs), Processing/Wiring (Arduino microcontrollers)

Physical Science and Engineering

Coursework (WSU):

Physics for Engineers, Biological Physics, Unified Systems Bioengineering

Mechanical Prototyping

Coursework (Yale):

Lab Instrumentation Design
Advanced Mechanical Instrumentation (welding)
Scientific Glass Blowing
+ 10 years of experience in optomechanical component design, prototyping, and manual and computer-controlled fabrication in plastics and metals (WSU, LANL, Yale, Paris Descartes)

Non-professional activities/qualifications:

General Aviation, PPL(A) SEP, Land
SCUBA Certified (NAUI 05/20/2004)
French language fluent (C1)