Adam H. Marblestone

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Experience

Google DeepMind *Research Scientist*, Oct 2018- Neuroscience-inspired artificial intelligence.

Kernel *Chief Strategy Officer*, Jan 2017-August 2018 Technologies for interfacing with the human brain. [$53M from leading VCs, 2020]

MIT Media Lab *Research Scientist and "Director of Scientific Architecting"*, Synthetic Neurobiology Group, 2014-2017. *Research affiliate*, 2017-2020
Advisor: Ed Boyden
Inventing methods for scalable and comprehensive brain circuit analysis, in-situ RNA sequencing, protein sequencing, 3D nanofabrication, and neural recording.

BioBright LLC *Co-founder*, 2012-2020 [Acquired by Dotmatics, 2020]
"Smart Lab" startup funded by investments, DARPA, and industry contracts.

Dana Farber Cancer Institute *Intern, 2007*
Advisors: William Shih, Shawn Douglas
Research on DNA nanotechnology. [Co-authored leading design software for the field, cited over 700 times in the scientific literature.]

Education

Harvard University *Ph.D., Biophysics, 2014*
Thesis: *Designing scalable biological interfaces*
Advisor: George Church
Research on bio-nanotechnology, synthetic biology and molecular tickertapes. Technology roadmaps for scalable neural recording and connectomics.

Yale University *B.S., Physics, 2009*
Advisor: Michel Devoret
Research on quantum information theory and superconducting quantum circuits.

Key Publications (* indicates equal contribution) [H-Index: 15, Citations: >2500]

Physical principles for scalable neural recording
Adam H. Marblestone*, Brad Zamft*, Yael Maguire, Mikhail Shapiro, Josh Glaser, Ted Cybulski, Dario Amodei, P. Benjamin Stranges, Reza Kalhor, David Dalrymple, Dongjin Seo, Elad Alon, Michel M. Maharbiz, Jose M. Carmena, Jan M. Rabaey, Ed Boyden**, George Church**, Konrad Kording**
Frontiers in Computational Neuroscience (2013). Featured in *Nature Physics*.

Towards an integration of deep learning and neuroscience
Adam H. Marblestone, Greg Wayne and Konrad Kording. *Frontiers in Computational Neuroscience* (2016)

Gaussian Gated Linear Networks
Budden*, Adam H. Marblestone*, Sezener*, Lattimore, Wayne** and Veness**. *ArXiv* 2006.05964 and In Review (2020)

Product Kanerva Machines: Factorized Bayesian Memory
Adam H. Marblestone*, Yan Wu*, Greg Wayne. *ArXiv* 2002.02385 (2020). ICLR 2020 "Bridging AI and Cognitive Science" (BAICS) workshop.
Video: http://baicsworkshop.github.io/program/baics_2.html

Expansion Sequencing: Spatially Precise In Situ Transcriptomics in Intact Biological Systems
S. Alon*, D. Goodwin*, F. Chen*, E. R. Daugharthy, Y. Bando, A. Payne, P. W. Tillberg, A. T. Wassie, …, G. M. Church**, Adam H. Marblestone**, E. S. Boyden**. *bioRxiv and In Review*. biorxiv.org/content/10.1101/2020.05.13.094268v1 [Co-senior author]

3-D Nanofabrication by Volumetric Deposition and Controlled Shrinkage of Patterned Scaffolds
Oran*, Rodriques*, Gao, Asano, Scott, Chen, Tillberg, Marblestone** and Boyden**. *Science.*14 Dec 2018: Vol. 362, Issue 6420, pp. 1281-1285
DOI: 10.1126/science.aau5119 [Co-senior author] See also: Perspective by Long and Williams. Featured by major news outlets and on MIT homepage.

Multiplexed neural recording along a single optical fiber via optical reflectometry
Sam Rodriques*, Adam H. Marblestone*, Max Mankin, Lowell Wood and Ed Boyden. *Journal of Biomedical Optics.* (2016)

Rosetta brains: a strategy for molecularly annotated connectomics
Adam H. Marblestone, Evan R. Daugharthy, Reza Kalhor, Ian D. Peikon, Justus M. Kebschull, Seth L. Shipman, Yuriy Mishchenko, Je Hyuk Lee, Konrad P. Kording, Edward S. Boyden, Anthony M. Zador and George M. Church. *ArXiv.* (2014)

Feasibility of 3D Reconstruction of Neural Circuits using Expansion Microscopy and Barcode-Guided Agglomeration
Yoon, Dai, Wohlwend, Marblestone*, Boyden*. *Frontiers in Computational Neuroscience* (2017)

Measuring cation-dependent DNA polymerase fidelity landscapes by deep sequencing
Brad Zamft*, Adam H. Marblestone*, Konrad Kording, Daniel Schmidt, Daniel Alarcon, Keith Tyo, Ed Boyden and George Church.
PLoS ONE (2012) **7**(8): p. e43876. Featured in *Nature*, *Wired* & elsewhere.

Exponential quantum enhancement for distributed addition with local nonlinearity
Adam H. Marblestone and Michel Devoret. *Quantum Information Processing*. Volume 9 #1 47-59 (2009)

Other Publications (* indicates equal contribution)

Rapid prototyping of three-dimensional DNA-origami shapes with caDNAno
Shawn Douglas, Adam H. Marblestone, Surat Teerapittayanon, Alejandro Vazquez, George Church and William Shih.
Nucleic Acids Research. 37:5001–6 (2009) Open-source software at: http://www.cadnano.org

Architecting Discovery: A Model of How Engineers Can Help to Accelerate the Understanding of the Brain
E.S. Boyden and A.H. Marblestone *Neuron* (2019)

A theoretical analysis of single molecule protein sequencing via weak binding spectra
Samuel G. Rodriques, Adam Marblestone, Edward Boyden. *PLoS ONE* (2019)

The atoms of neural computation Gary Marcus, Adam H. Marblestone and Tom Dean. *Science*. (2014)
Steven Pinker's Twitter endorsement: "groundbreaking new ideas"
+ FAQ: arxiv.org/abs/1410.8826
+ How thalamic relays might orchestrate deep training and symbolic computation in the brain Ken Hayworth and Adam Marblestone. *bioRxiv.* (2018)

Statistical analysis of molecular signal recording
Joshua Glaser, Bradley Zamft*, Adam H. Marblestone*, Jeffrey Moffitt, Keith Tyo, Edward Boyden, George Church and Konrad Kording.
PLoS Computational Biology (2013)

Nanoscale imaging of RNA with expansion microscopy
Fei Chen*, Asmamaw T. Wassie*, Allison J. Cote, Anubhav Sinha, Shahar Alon, Shoh Asano, Evan R. Daugharthy, Jae-Byum Chang, Adam Marblestone, George M. Church, Arjun Raj, Edward S. Boyden. *Nature Methods.* (2016)

Expansion microscopy of lipid membranes
Emmanouil D. Karagiannis*, Jeong Seuk Kang*, Tay Shin, Amauche Emenari, Shoh Asano, Leanne Lin, Emma K. Costa, Adam H. Marblestone, Narayanan Kasthuri, Edward S. Boyden. *BioRxiv. In Review.*

Conneconomics: the economics of large-scale, dense, high-resolution neural connectomics
Adam H. Marblestone, Evan R Daugharthy, Reza Kalhor, Ian Peikon, Justus Kebschull, Seth L Shipman, Yuriy Mishchenko, David A Dalrymple, Bradley M Zamft, Konrad P Kording, Edward S Boyden, Anthony M Zador, George M Church. *BioRXiv.* (2013)

Designing scalable biological interfaces Adam H. Marblestone. PhD Thesis. Biophysics. Harvard University. (2014)=

Designing tools for assumption-proof brain mapping Adam H. Marblestone and Ed Boyden. *Neuron*. (2014)

Understand the cogs to understand cognition
Marblestone, Wayne and Kording. Commentary on: Building Machines That Learn and Think Like People by Lake et al. *Behavioral and Brain Sciences*. (2017)

Malthusian reinforcement learning
Joel Z. Leibo, Julien Perolat, Edward Hughes, Steven Wheelwright, Adam H. Marblestone, Edgar Duéñez-Guzmán, Peter Sunehag, Iain Dunning, Thore Graepel. *ArXiv*. 1812.07019 (2019) Accepted at multi-agent systems conference

Multiplexed in-vivo his-tagging of enzyme pathways for in-vitro single-pot multi-enzyme catalysis
Harris H. Wang*, Po-Yi Huang*, George Xu, Wilhelm Haas, Adam H. Marblestone, *et al. ACS Synth. Biol.,* 2012, 1 (2), pp. 43–52

Gene assembly from chip-synthesized oligonucleotides
Nikolai Eroshenko*, Sriram Kosuri*, Adam H. Marblestone, Nicholas Conway and George M. Church. *Curr. Protoc. Chem. Biol* (2012)

Molecular threading: mechanical extraction, stretching and placement of DNA molecules at a liquid-air interface
Andrew Payne*, Michael Andregg*, Kent Kemmish, Mark Hamalainen, Wolfgang Lehrach, C. Bowell, A. Bleloch, N. Klejwa, K. Schatz, H. Stark, Adam H. Marblestone, George Church**, Chris Own** and William Andregg**.** *PLoS ONE* 8(7): e69058.

Highly multiplexed three-dimensional subcellular transcriptome sequencing in situ
Jay Lee*, Evan Daugharthy*, Jonathan Scheiman, Reza Kalhor, Joyce Yang, Thomas Ferrante, Richard Terry, Sauveur Jeanty, Chao Li, Ryoji Amamoto, Derek Peters, Brian Turczyk, Adam H. Marblestone, Samuel Inverso, Amy Bernard, Prashant Mali, Xavier Rios, John Aach and George M. Church. *Science.* (2014)

Spatial information in large-scale neural recordings
Ted Cybulski*, Josh Glaser*, Adam H. Marblestone, Brad Zamft, Ed Boyden, George Church and Konrad Kording. *Frontiers in Computational Neuroscience.* (2014)

Rosetta brain George Church, Adam H. Marblestone and Reza Kalhor. The Future of the Brain: Essays from the World's Leading Neuroscientists. (2014)

How to study the brain Gary Marcus, Adam H. Marblestone and Jeremy Freeman. *The Chronicle of Higher Education.* (2014)

Grand challenges for global brain sciences
Joshua T. Vogelstein, Katrin Amunts, Andreas Andreou, Dora Angelaki, Giorgio Ascoli, Cori Bargmann, Randal Burns, Corrado Cali, Frances Chance, Miyoung Chun, George Church, …, Adam H. Marblestone, David Markowitz, Justin McArthur, Brett Mensh, ..., Jane Roskams, Terry Sejnowski, Fritz Sommer, Nelson Spruston, Larry Swanson, Arthur Toga, R. Jacob Vogelstein, Rafael Yuste, Anthony Zador, Richard Huganir, Michael Miller. *ArXiv*. (2016)

DNA binding strength increases the processivity and activity of a Y-Family DNA polymerase
Wu J, De Paz A, Zamft BM, Marblestone AH, Boyden ES, Kording KP, Tyo KE. *Scientific reports*. 2017 Jul 6;7(1):4756.

Ethical guidelines for neurotechnologies and machine intelligence Rafael Yuste, Sara Goering, ..., Marblestone, et al. *Nature*. (2017)

Developing Next-generation Brain Sensing Technologies – A Review
Jacob T. Robinson, Eric Pohlmeyer, Malte C. Gather, Caleb Kemere, John E. Kitching, George G. Malliaras, Adam Marblestone, Kenneth L. Shepard, Thomas Stieglitz and Chong Xie. *IEEE Sensors*. (2019)

High-resolution mapping of DNA polymerase fidelity using nucleotide imbalances and next-generation sequencing
Alexandra M. de Paz, Thaddeus R. Cybulski, Adam H. Marblestone, Bradley M. Zamft, George M. Church, Edward S. Boyden, Konrad P. Kording, Keith E. J. Tyo. *Nucleic Acids Research*. (2018) DOI: 10.1093/nar/gky296

Signal-to-pump back-action and self-oscillation in a double-pump Josephson parametric amplifier
Archana Kamal, Adam H. Marblestone and Michel Devoret. *Physical Review B*. 79:184301 (2009)

In preparation, unpublished or working papers

Expansion in-situ sequencing of RNA neuronal barcodes
Richie Kohman, ..., Zador, Boyden, Church, Marblestone *In prep.*

Review of proposed mechanisms for symbolic variable binding in the brain
Marblestone, Hayworth, Marcus *Working whitepaper* (2016)

An optical observatory of molecular complexity in the normal and diseased brain
Mermelstein, Abnet, Rodriques, Marblestone, Boyden. *Whitepaper draft conveyed to Argonne National Lab and Lawrence Berkeley National Lab.*

In-situ technologies enable a pan-omic human cell atlas
Shahar Alon, Edward S. Boyden, Fei Chen, George M. Church, Evan R. Daugharthy, Samuel Inverso, Adam Marblestone, Sam Rodriques, Chao-Ting Wu
Whitepaper circulated at Chan-Zuckerberg Initiative Human Cell Atlas meeting (Feb 2017)

Genetic error-correcting codes using in-vivo ssDNA technologies
Esvelt, Marblestone *Unpublished design manuscript* (2012)

Awards and honors

Technology Review 35 Innovators Under the Age of 35
Fannie and John Hertz Foundation Fellowship
James Mills Peirce Fellowship at Harvard
Barry M. Goldwater Scholarship
Stanford Graduate Fellowship (declined)
Fulbright Scholarship (declined)

Patents

In-situ nucleic acid sequencing of expanded biological samples
Inventors: Edward Stuart Boyden, Fei Chen, Shahar Alon, George Church, Paul Warren Tillberg, Adam Marblestone, Evan Daugharthy.
https://www.google.com/patents/US20160304952
Issued August 28th 2018 (Assigned to MIT)

Non-invasive optical detection system and method of multiple-scattered light with swept source illumination
Inventors: H Ruan, A Marblestone, R Horstmeyer, Y Shen, H Zhou, J Alford
US Patent App. 16/393,002 (Assigned to HI LLC)

Time-of-flight optical measurement and decoding of fast-optical signals
Alford J, Marblestone A, Vellekoop I, Sobek D, Henninger M, Robinson B, Shen Y, Horstmeyer R, inventors; Hi LLC, assignee.
US Patent App. US 16/533,133 (Assigned to HI LLC)

Non-invasive optical detection system and methods in highly scattering medium
Inventors: Jamu Alford, Adam Marblestone
US20190313912A1 (Assigned to HI LLC)

System and method for simultaneously detecting phase modulated optical signals
Inventors: Changhuei Yang, Adam Marblestone, Jamu Alford, Daniel Sobek, and Christian Wentz
https://patents.google.com/patent/US10016137B1/en
US 10,016,137 B1 Issued July 10th 2018 (Assigned to HI LLC)

Systems and methods for quasi-ballistic photon optical coherence tomography in diffusive scattering media using a lock-in camera detector
Inventors: Yang, Marblestone, Alford
https://patents.google.com/patent/US20190183343A1/en
US 10,219,700 Issued March 5th 2019 (Assigned to HI LLC)

Devices and methods to convert conventional imagers into lock-in cameras
Inventors: J Alford, A Marblestone
http://www.freepatentsonline.com/10368752.html
US Patent App. 15/988,799 (Assigned to HI LLC)

Ultrasound modulating optical tomography using reduced laser pulse duration
https://patents.google.com/patent/US20190269331A1
Jamu Alford, Adam Marblestone, Changhuei Yang. US16/266,818 (Assigned to HI LLC)

Nanofabrication by shrinking of patterned gels
Inventors: Rodriques, Marblestone, Chen, Tillberg, Boyden.
https://patents.google.com/patent/US20170081489A1 (Assigned to MIT)

Multiplexed Signal Amplified FISH via Splinted Ligation Amplification and Sequencing
Inventors: Chen, Alon, Wassie, Sinha, Marblestone, Boyden.
https://patents.google.com/patent/US20180216161A1 (Assigned to MIT)

Single molecule protein identification by spectral sequencing
Inventors: Rodriques, Marblestone, Boyden. *US patent application filed.* (Assigned to MIT)

Ligation-based assembly of nucleic acid molecules guided by self-assembled DNA nanostructures
Inventors: Zhang, David Y; Marblestone, Adam H; Yin, Peng. *US provisional patent filed.* (Assigned to Harvard)

Methods and apparatus for multiplexed neural interfacing via optical micro-fibers
Inventors: Marblestone, Amodei, Church, Boyden, Wood. *US provisional patent filed.* (Assigned to MIT)

Other Experience

Protocol Labs	Volunteer Consultant (Summer 2018)	Software tools for accelerating science
OccamzRazor	Advisory board member (2015-2018)	Knowledge capture and sharing platform for scientists
Expii	Consultant on scientific knowledge graphs (2014)	Online participatory math education.
Beagle	Co-steering (w/ Juan Batiz-Benet) a project to develop a social annotation tool for scientific literature (2014-) [paused]	
Fannie and John Hertz Foundation	Fellowship Interviewer (2015-)	Identifying next-generation science/engineering leaders
Open Philanthropy Project	Scientific Advisor (2013-2016)	Advising on biological tools & techniques, AI, nanotechnology, science policy, & more
Brain Preservation Foundation	Scientific Advisor (2015-2018)	
Shannon Labs	Informal advising (Summer 2018)	
MIT Media Lab	Advisory group member on the "Future of Science+Art/Design/Engineering" (2016-) [$10,000 award]	
Wyss Center (Geneva)	Strategy input	
Neuralink (July-Nov 2016)	Early unpaid consulting for what became the company Neuralink -- directly advised Elon Musk, helped seed initial team	

Volunteer executive advisor: **Institute for Transformational Biotechnology (IXBio)** (2018)
Informally advising members of the **UK government** on science policy
Scientific Peer Review: *PLoS Computational Biology*, *JoVE, Nature Communications, MIT Press, Neuron*, ICLR BAICS, NeurIPS, guest editor for *Frontiers*
Scientific Workshops Organized:
"Molecular Additive Manufacturing", Cambridge University UK, Led workshop (2016) Sketched how to build a molecular 3D printer, w/ leading nanotechnologists
Kavli Futures Symposium, "Towards a Taxonomy of Cortical Computations", Co-organized with Gary Marcus, Funded $60k by Kavli Foundation (2015)
Cosyne Workshop, "Tools and Approaches for Ground-Truth Neuroscience", Co-organized with Annabelle Singer (2015)
CIFAR workshop on Mind-Machine Links (2019), Co-organized with Blake Richards and Alona Fyshe
New York Stem Cell Foundation Workshop, "Immuno-engineering", Co-initiated workshop (2015)
Misc:
Co-creator: **Neurotechnology Architecting Network**, featured in White House BRAIN Initiative 9/30/2014 announcement, http://neuroarchitecting.org/
Participant: NTC Neuro-Ethics Workshop (2017), Kavli Futures Symposium: Neurotechnology (2017), Deep Learning in the Brain workshop at UPenn (2018)
Rapporteur: BrainX.io global brain research coordination meeting (2016)

Selected Talks/Lectures

Tianjin University (Tianjin, China): 5 lectures for undergraduates on *design principles for DNA self-assembly* (2012) [with M. Dai]
Harvard Medical School *nm2cm: bridging top-down and bottom-up nanotechnology* (2012) [initiated and organized meeting]
TEDx Beacon Street (Boston, USA): *Billion-year-old information technologies* (2012)
COSYNE Beyond Optogenetics Workshop (Snowbird, USA): *Molecular ticker-tapes* (2013)
Bar-Ilan University (Ramat Gan, Israel): *Molecular information storage technologies* (2013)
Stanford University (Palo Alto, USA): Guest lecturer in the course *Computational Models of the Neocortex* (2013)
Harvard Medical School *Physics of brain activity mapping* (2013) [initiated and co-organized meeting]
Rehabilitation Institute of Chicago (Chicago, USA): *An architecture for neural recording via optical time-domain reflectometry* (2013)
Vannevar Group (Palo Alto, USA): *Collaboratively surveying neuro-technological possibility space* (2013)
MIT Media Lab (Cambridge MA, USA): *Networked biology* (2014)
MIT Center for Bits and Atoms workshop on Bits <=> Biology (Cambridge MA, USA): *Digital encoding for scalable brain mapping* (2014)
University of Waterloo Theoretical Neuroscience Summer School (Waterloo ON, CA): *Semantic pointer operations on word similarity spaces* (2014)
Northeastern University Center for Complex Network Research (Boston MA, USA): *Towards a complete activity map for the smallest brain* (2014)
White House OSTP/NPI Photonics Industry Neurotechnology Group (Washington DC, USA): *Photonics needs for scalable neural interfacing* (2014)
Radcliffe Institute Workshop on Programmable Molecular Robots (Cambridge MA, USA): *Bigger nanorobots* (2014)
MIT Biophysics Program Student Seminar Series (Cambridge MA, USA): *The physics of whole-brain mapping* (2014)
Society for Neuroscience 2014 (Washington DC, USA): *Fiber optic reflectometry as a next-generation electrode* (2014)
MSRI workshop on Breaking the Neural Code (Berkeley, USA): *Rosetta brain* (2014)
Stanford University (Palo Alto, USA): Guest lecturer in the course *Computational Models of the Neocortex* (2015)
Harvard Effective Altruism (Cambridge, USA): *Effective altruism, technological convergence and scientific roadmapping* (2015)
Digital Garage Conference: Hacking the Human Body (San Francisco, USA): *Mapping the brain in search of the architecture of the mind* (2015)
MIT Media Lab (Cambridge, USA): Guest lecture in the couurse *New Destinations in Artificial Intelligence* (2015)
MSRI workshop on the Theory of Neural Computation (Berkeley, USA): *Rosetta brain maps and what they might teach us* (2015)
Brandeis Computational Neuroscience Journal Club (Waltham, USA): *Towards technologies and frameworks for scalable brain mapping* (2016)
Panelist for MIT Center for Brains Minds and Machines (Cambridge, USA) *Debate on AI and neuroscience, moderated by Max Tegmark* (2016)
Future of Humanity Institute at Oxford (Oxford, UK): *A roadmap for connecting neuroscience and machine learning* (2016)
Stanford University (Palo Alto, USA): Guest lecturer in the course *Computational Models of the Neocortex* (2016)
Wyss Institute (Boston, USA): IARPA MICRONS site visit talk on *ExM validation of FISSEQ-BOINC connectomics* (2016)
SciFoo (Mountain View, USA): *Participant in panel discussion on artificial intelligence, co-led session on scientific tools* (2016)

Sanger Institute (Hinxton, UK): Talks on *FISSEQ-BOINC connectomics, and on BioBright smart lab* (2016)
IARPA MICRONS Technical Exchange Meeting (Bethesda, USA): *Validating FISSEQ-BOINC connectomics* (2017)
US Army Neural-Inspired AI Army Science Planning Strategy Meeting (Aberdeen, USA): *Towards an integration of deep learning and neuroscience* (2016)
Columbia Workshop on Brain Circuits, Memory and Computation (NY, USA): *Towards neural substrates of variable binding and deep learning* (2017)
Cosyne Workshop - Electrons, fluorophores, and nucleotides: bridging the gaps in high-throughput connectomics (Snowbird, USA):
Towards a "best of all worlds" connectomics: integrating expansion microscopy tracing, in-situ barcoding and machine learning (2017)
Connectomics Berlin (Berlin, Germany): *Combining expansion microscopy and in-situ barcoding for connectomics* (2017)
Stanford University (Palo Alto, USA): Guest lecturer in the course *Computational Models of the Neocortex* (2017)
Quantifying Structure in Large Neural Datasets (New York, USA): *Rosetta brain neuroanatomy* (2017)
Advancing Neuroscience with the National Labs (Chicago, USA): *Scalable optical connectomics* (2017)
Machine Learning meets Biology (Geneva, Switzerland): *Towards an integration of deep learning and neuroscience* (2017)
Blue Brain Project (Geneva, Switzerland): *Scalable optical connectomics* (2017)
YConf (San Francisco, USA): *Could new kinds of circuit maps reveal the brain's computational architecture?* (2017)
Effective Altruism Global (Boston, USA): *Accelerating neuroscience progress* (2017)
Fannie and John Hertz Foundation Summer Workshop (San Diego, USA): *Kernel* (2017)
Fannie and John Hertz Foundation East Coast Retreat (Cape Cod, USA): *Towards an integration of deep learning and neuroscience* (2017)
Neuromodulation of Neural Microcircuits (Lausanne, Switzerland): *Molecularly annotated connectomics* (2017)
Harvard Effective Altruism Club (Cambridge, USA): *Nanotechnology and neuroscience* (2017)
MIT Effective Altruism Club (Cambridge, USA): *Accelerating neuroscience progress* (2017)
Harvard Effective Altruism Club (Cambridge, USA): *The Turing Test #3 (podcast): Adam Marblestone* (2017)
IEEE Sensing the Brain workshop (Glasgow, Scotland): *Physical limits, hybrid modalities and whole-brain neural recording* (2017)
University of Montreal (Montreal, Canada): *Towards an integration of deep learning and neuroscience* (2017)
University of Indiana (Bloomington, USA): *Towards an integration of deep learning and neuroscience* (2018)
US National Institutes of Health (Bethesda, USA): *Towards an integration of deep learning and neuroscience* (2018)
Google DeepMind (London, UK): *Towards an integration of deep learning and neuroscience* (2018)
Institute of Neuroinformatics (Zurich, Switzerland): *Towards an integration of deep learning and neuroscience* (2018)
Emerging Technologies Conference (Cambridge, MA): *Scalable neurotechnology* (2018)
Oxford Future of Humanity Institute (Oxford, UK): *On seeing and manipulating molecules* (2019)
Stanford University (Palo Alto, USA): Guest lecturer in the course *Computational Models of the Neocortex* (2019)
HHMI Janelia (Ashburn, Virginia, USA): Participant in AI-neuroscience workshop (2019)
Topos House (San Francisco, USA): *Surveying physics, chemistry, biology & computation to identify strategies for scalable neuroscience* (2020)
UPenn (Philadelphia, USA): *Surveying physics, chemistry, biology & computation to identify strategies for scalable neuroscience* (2020)
ICLR Bridging AI and Cognitive Science workshop (virtual): *Product Kanerva Machines* (2020)

Selected Posters

Targeted and untargeted in situ sequencing in thick, physically magnified brain tissue
Anubhav Sinha, Daniel Goodwin, Shahar Alon, Asmamaw Wassie, Fei Chen, Yi Cui, Yosuke Bando, Atsushi Kajita, Andrew Payne, Chun-Chen Yao, George M Church††*, Adam H Marblestone††, Edward S Boyden†††*. *Society for Neuroscience* (2019).

In situ mapping of RNA at subcellular resolution using expansion sequencing (ExSeq) in intact brain tissue
Daniel Goodwin, Shahar Alon, Fei Chen, Asmamaw Wassie, Andrew Payne, Anubhav Sinha, Yosuke Bando, Atsushi Kajita, Karl Marrett, Evan Daugharthy, Ho-Jun Suk, Ru Wang, Paul Tillberg, Paul Reginato, Nikita Pak, Adam Marblestone, George Church, Edward S Boyden.
Society for Neuroscience (2018).

Next-generation expansion microscopy with lipid labels for morphological analysis of neurons.
J. Kang, E. Karagiannis, J-B. Chang, G. Huynh, Adam H. Marblestone and E. Boyden. *Society for Neuroscience* (2016)

3D Reconstruction of Neural Circuits using Expansion Microscopy
Y-.G. Yoon, P. Dai, J. Wohlwend, J.-B. Chang, A. Marblestone* and E. S. Boyden*. *Society for Neuroscience* (2016)

Expansion microscopy of lipids for scalable morphological analysis of neurons and neural circuits
E. Karagiannis, Adam H. Marblestone, E. Boyden. *Society for Neuroscience* (2015)

Expansion Sequencing (ExSEQ): comprehensive in-situ transcriptome characterization throughout intact brain circuits
S. Alon, F. Chen, E. Daugharthy, P. Tillberg, Adam H. Marblestone, A. Wassie, G. Church, E. Boyden. *Society for Neuroscience* (2015)

Vascular Interfaces for Brain Imaging and Stimulation
Bob Desimone, Edward Boyden, Elazer Edelman, Ken Shepard, Colin Derdeyn, Eric Leuthardt, Bruce Fischl, Jon Polimeni, George Church, Adam H. Marblestone.
2nd Annual BRAIN Initiative Investigators Meeting, Bethesda, MD. (2015)

Physical Principles for Whole-Brain Activity Mapping
Adam H. Marblestone, Bradley Zamft, Yael Maguire, Mikhail Shapiro, Joshua Glaser, Ben Stranges, Reza Kalhor, DJ Seo, Elad Alon, Michel Maharbiz Jose Carmena, George Church, Konrad Kording and Ed Boyden. *Society for Neuroscience* (2014)

DIY physiological sensors: towards the Arduino of physiology Charles Fracchia (MIT), Adam H. Marblestone and Stephen Heisig (IBM)
GET: Genomes, Environments & Traits (2013)

Controllable release of gold nanoparticles from a switchable DNA box Sun*, Schaus*, Wu*, Marblestone, Wang, Perkons, Shih and Yin
10th Annual Conference, Foundations of Nanoscience: Self-Assembled Architectures and Devices (2013)

Continuous in-vivo multiplex genome engineering Kevin Esvelt*, Adam H. Marblestone* and George Church**.** *Wyss Institute Annual Retreat* (2012)

Acknowledgements in published works

Liu et al, "Imaging through highly scattering human skulls with ultrasound-modulated optical tomography" (2020)
Marcus, "The Next Decade in AI: Four Steps Towards Robust Artificial Intelligence" (2020)
Merel et al, "Hierarchical motor control in mammals and machines" (2019)
Yu, Barry et al, "Expansion microscopy of C. Elegans" (2019)
Lillicrap and Kording, "Can neural computation be compressed enough for us to understand it?" (2019)
Drexler, "Reframing super-intelligence" (2019)
Drexler, "Molecular Imprinting: The missing piece in the puzzle of abiogenesis?" *ArXiv* (2018)
Landsdell and Kording, "Towards learning to learn" (2018)
Rolnick et al. "Morphological Error Detection in 3D Segmentations" *ArXiv* (2017)
Payne, "Towards sequencing by synthesis in-situ" (2017)
Legenstein, Papadimitriou, Vempala, Maass "Assembly pointers for variable binding in networks of spiking neurons" *NIPS CoCo Workshop* (2016)
Kalhor, Reza, Prashant Mali, and George M. Church. "Rapidly evolving homing CRISPR barcodes." *Nature Methods* (2016)
Jonas, Eric and Kording, Konrad. "Can a neuroscientist fix a microprocessor?"
Chen, Fei, Paul W. Tillberg, and Edward S. Boyden. "Expansion microscopy" *Science* 347.6221 (2015): 543-548.
Chen, Ho-Lin, David Doty, and Shinnosuke Seki. "Program Size and Temperature in Self-Assembly." *Algorithmica* 72.3 (2015): 884-899.
Seo, Dongjin, et al. "Neural dust: An ultrasonic, low power solution for chronic brain-machine interfaces." *arXiv preprint arXiv:1307.2196* (2013).
Douglas, Shawn, Ido Bachelet and George Church. "A logic-gated nanorobot for targeted transport of molecular payloads." *Science* 335.6070 (2012)

Press coverage

Quoted in "What's new and what isn't about Elon Musk's brain-computer interface" | Technology Review (July 2019)
Mentioned and cited in "Team invents method to shrink objects to the nanoscale" | MIT News (Dec 2018); highlighted by many news sites, CNN homepage
Quoted in Quanta Magazine, Sept 2018
Mentioned in EmTech MIT: How AI and biomedical innovations are transforming health care, ZDNet, Sept 2018
Interviewed on Brain Inspired neuroscience podcast, Sept 2018
"Kernel neuroscience company seems to be making radical progress...", futuretimeline.net, July 2018
Technology Review 35 Innovators Under 35 – Adam Marblestone, June 2018
Hertz Fellow Adam Marblestone Named to MIT Technology Review's 2018 Innovators Under 35 List, June 2018
Profiled in Hertz Foundation "Faces of the Foundation", Feb 2018
Mentioned in On Intelligence, Phys.org, April 2017
Mentioned in Import AI, Feb 2017
Mentioned in "Building better brains", Neurotech Business Report, 2017
Mentioned in "Elon Musk backs brain-computer interface venture", International Business Times, March 2017
Mentioned in "Silicon valley's race to develop a brain-computer interface", Technology Review, March 2017
Mentioned in "Kernel is trying to hack the human brain – but neuroscience has a long way to go", The Verge, Feb 2017
Quoted in "Kernel Acquires KRS to Build Next-Generation Neural Interfaces" (2017)
Cited in "Recording the brain with light", Hertz Foundation Newsletter (2016)
Cited in "Seeing RNA at the nanoscale", Science Bulletin, 2016
Interviewed for the O'Reilly report "Artificial Intelligence: Teaching Machines to Think Like People" by Jack Clark (2016)
Mentioned in "The smart lab blends the best of humans and automation", Glenn Martin, O'Reilly Radar, July 2016
Quoted in "Government seeks high-fidelity brain computer interface", Adam Piore, Technology Review, Feb 2016
Mentioned in "Wyss Institute will lead IARPA funded brain mapping consortium", Eurekalert, Jan 2016
Cited in "Brain-machine interfaces as a challenge to the 'moment of singularity'", Philip Kennedy, H+ Magazine, Dec 2015
Mentioned in "Face it, your brain is a computer", Gary Marcus, New York Times Sunday Review, June 2015
Mentioned in "Fifteen MIT scientists receive NIH BRAIN Initiative grants", MIT News, Sept 2014
Cited in "Brain Teaser", Mark Buchanan, Nature Physics, September 2013
Cited in "The world according to Itskov: Futurists convene at GF2045 (Part 2)", Stuart Mason Dambrot, Phys.org, Aug 2013
Cited in "Physical principles for scalable neural recording", John Hewitt, Medical Xpress, July 2013
Cited in "Neuroscience: Solving the brain", Alison Abbott, Nature, July 2013
Cited in "The science behind Obama's brain project", Jean-François Gariépy, BrainFacts.org, April 2013

Other Educational Experiences

Center for Theoretical Neuroscience Summer School, *large-scale spiking neural network models w/ NEF + SPA*, University of Waterloo, 2014
NSF I-CORPs, *completed program as entrepreneurial co-lead for BioBright,* http://www.nsf.gov/awardsearch/showAward?AWD_ID=1522517, 2015
Stanford University Mathematics Camp, *algebraic topology*, Stanford University, 2004

Teaching

MIT Instructor for "Revolutionary Ventures" graduate course (MIT Course Numbers: 9.455 ~ 15.128 ~ 20.454 ~ MAS.883) at MIT in Fall 2015
Instructor for "Cognitive Integration" seminar (MAS.S63) at MIT Media Lab in Spring 2016
Co-created C. elegans optogenetics demo lab for the 2014 "Neurotechnology In Action" graduate course, based on cheap off-the-shelf hardware
Individual students supervised: J. Wohlwend, S. Rezchikov, D. Barabasi (Notre Dame), G. Khimulya (Harvard). Mentor for MIT PRIMES.

Harvard *Co-mentored Harvard's biomolecular engineering and synthetic biology team*: 3rd overall (2011) and best wiki (2012) in BIOMOD
Individual students supervised: N. Donoghue (Brown), A. Payne (Toronto), J. Lovelock (Toronto), W. Chen, J. Pritt, E. Wu
Teaching Fellow: Bio-Inspired Molecular Engineering (2011), Biomolecular Engineering and Synthetic Biology (2011, 2013)
Co-developed course structure and materials. *Certificate of Distinction in Teaching.*

Yale *Peer Tutor*: Intensive Introductory Physics

Blog

Longitudinal Science: longitudinal.blog
Posts on cross-disciplinary technology topics including connectomics, AI, climate change

Technical Skills

Programming: JAX, TensorFlow, Python; Earlier: C, Java, Actionscript, Mathematica
Machine learning and computational neuroscience: Implementing deep learning and deep reinforcement learning models including development of new memory augmented neural nets, probabilistic inference algorithms, research level understanding of modern machine learning including integrated agent models, basic neural dynamics simulations of biological networks, attractor neural nets, etc.
Experimental: basic electronics design and production, microcontrollers, basic bench optics, basic micro-fluidic device fabrication; mechanical rapid prototyping (laser cutter, 3D printer, CNC micro-mill); nano-scale imaging (AFM, TEM, SEM, TIRF); molecular biology, Gibson cloning, MAGE, liquid handling robot; bacterial cell culture; DNA nanostructures; Illumina sequencing
Selected coursework (at Amherst College, Yale, Harvard and MIT)*:* quantum mechanics I & II, statistical physics, mesoscopic physics, quantum theory of solids, physics of information technology, general relativity, classical mechanics, principles of neuro-science, principles of neuro-engineering, mathematical methods of physics, how to make (almost) anything, biological instrumentation and measurement, advanced computational biology, algorithms, data structures and programming techniques, experimental strategies in cellular biology, biochemistry, organic chemistry, vector calculus and linear algebra, real analysis, groups rings & fields, intro to Lie groups, theory of statistics, neuro-technology ventures

Research Funding

IARPA MICRONS D16PC00008 — PI: George Church — 2016-2020
Cortical architecture and algorithms for machine listening
The goal of this project is to develop cortically inspired algorithms using brain mapping. We will demonstrate novel scalable connectomic technologies based on in-situ DNA barcode readout, similar to those described in our Rosetta Brain whitepaper (http://arxiv.org/abs/1404.5103).
Role: Co-investigator, PI for MIT, co-authored proposal. Funding: >$21,000,000 across several institutions
https://wyss.harvard.edu/wyss-institute-will-lead-iarpa-funded-brain-mapping-consortium/
Preliminary results on expansion sequencing of barcodes featured at: https://spectrum.ieee.org/biomedical/imaging/ai-designers-find-inspiration-in-rat-brains

DARPA HR0011-16-9-0004 — PI: Charles Fracchia — 2016-2017
BioBright: A platform for real-time tracking of biological experiments
Role: Led proposal conception, writing, budgeting and contract negotiation Funding: $698,000
Preliminary results featured at: https://biobright.com/darpa-press-release.html

NIH 1R24MH106075-01 — PI: Robert Desimone — 2014-2017
Vascular interfaces for brain imaging and stimulation
The goal of the study is to initiate a collaborative effort to design a human-applicable vascular neural interface for multiplexed neural recording and stimulation, and to carry out preliminary pilot theoretical and experimental projects to validate the basic parameters of the resulting concepts.
Role: Collaborator, co-authored proposal, organized proposal team Funding: ~$1,500,000
http://news.mit.edu/2014/fifteen-mit-scientists-receive-nih-brain-initiative-grants-0930

MIT McGovern Institute Neurotechnology (MINT) program — PI: Michael Mermelstein — 2015
3D tessellation imaging (3DTI) for large-volume, super-resolution, multi-color microscopy
Role: Co-authored proposal Funding: $100,000

Open Philanthropy Project — 2016-2019
Gift to support Synthetic Neurobiology Group research
Role: Co-authored proposal Funding: $2,970,000 plus additional follow-on funding
http://www.openphilanthropy.org/focus/scientific-research/miscellaneous/massachusetts-institute-technology-synthetic-neurobiology-group

NIH R01-MH103910-02 (Transformative Research Award) — PI: Kording, Church, Boyden, Tyo — 2013-2017
Recording neural activity into DNA
Role: Co-authored proposal, generated preliminary data Funding: >$9,000,000 across the three institutions
http://news.feinberg.northwestern.edu/2013/12/kording_neurons/

MetaKnowledge Network — PI: Marblestone, Boyden — 10/2014-08/2015
Beagle: A tool to empower individuals and teams to organize and share scientific insights
Role: Co-PI, authored proposal, oversaw project
http://www.knowledgelab.org/news/detail/1.4_million_in_grants_awarded_to_metaknowledge_projects Funding: ~$110,000

NIH R01 — PI: Kasthuri, Cai, Boyden — 2016-
An Accessible Toolbox for Comprehensive Analysis of Neural Tissue Architecture
Role: Co-authored proposal Funding: >$1,500,000 across three institutions
http://grantome.com/grant/NIH/R01-MH110932-01
See also: https://www.biorxiv.org/content/10.1101/2020.02.24.963538v1, https://www.biorxiv.org/content/10.1101/2020.04.07.030593v2