John H. Abel

Senior Biomedical Data Scientist, PathAI
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Education

Harvard University, PhD Systems Biology 2018
Dissertation: "A computational approach to analysis and control of mammalian circadian dynamics."
Advisors: Francis J. Doyle III, Elizabeth B. Klerman

UC Santa Barbara, MS Chemical Engineering 2015
Thesis: "Stochasticity and synchrony in the mammalian circadian network"
Advisors: Francis J. Doyle III, Linda R. Petzold

Tufts University, BS Chemical Engineering *magna cum laude* 2013
Honors thesis advisor: Hyunmin Yi

Additional Training

Massachusetts General Hospital and **MIT**, Postdoctoral Fellow, 2018 - 2020
Research: Automatic control of the anesthetized brain
Advisor: Emery N. Brown

Professional appointments (grouped in *ital*)

	PathAI
2021 -	Senior Biomedical Data Scientist
2020 - 2021	Biomedical Data Scientist
	Massachusetts Institute of Technology
2018 - 2021	Research Affiliate, Picower Institute for Learning and Memory
	Massachusetts General Hospital
2018 - 2020	Postdoctoral Research Fellow, Department of Anesthesia
	Harvard University
2015 - 2018	Graduate Researcher, Department of Systems Biology, Harvard University
	UC Santa Barbara
2013 - 2015	Graduate Researcher, Department of Chemical Engineering
	General Electric Aviation
2012 - 2012	Engineering Intern
	Tufts University
2011 - 2013	Undergraduate Researcher, Department of Chemical Engineering

Honors, awards, and fellowships

2020 Research Merit Award, Society for Research on Biological Rhythms
2019 Certificate of Distinction in Teaching, Harvard University
2019 NIH/NIA Postdoctoral F32 Ruth L. Kirschstein NRSA Fellowship
2018 Postdoctoral NIH T32 Traineeship, Harvard Medical School/Brigham and Women's Hospital
2016 Predoctoral NIH T32 Traineeship, Harvard Medical School/Brigham and Women's Hospital
2016 Research Excellence Award, Society for Research on Biological Rhythms
2014 Mellichamp Fellowship in Systems Biology (UC Santa Barbara)
2014 Honorable Mention, NSF Graduate Research Fellowship Program
2013 High Thesis Honors (Tufts University)
2012 Meritorious Winner, COMAP Mathematical Contest in Modeling
2011 Meritorious Winner, COMAP Mathematical Contest in Modeling

Scholarly Activities

https://scholar.google.com/citations?user=1AYZ0IAAAAAJ

Journal publications

1. A Shanker, **JH Abel**, P Mathur, E Work, G Schamberg, A Sharkey, R Bose, V Rangasamy, V Senthilnathan, EN Brown, and B Subramaniam, "Perioperative multimodal general anesthesia focusing on specific CNS targets in patients undergoing cardiac surgeries: the Pathfinder feasibility trial," *Frontiers in Medicine*, 1811, 2021. doi:10.3389/fmed.2021.719512

2. I Cajigas, KC Davis, B Meschede-Krasa, NW Prins, S Gallo, JA Naeem, A Palermo, A Wilson, S Guerra, BA Parks, L Zimmerman, K Gant, AD Levi, WD Dietrich, L Fisher, S Vanni, JM Tauber, IC Garwood, **JH Abel**, EN Brown, ME Ivan, A Prasad, and J Jagid, "Implantable brain-computer interface for neuroprosthetic-enabled volitional hand grasp restoration in spinal cord injury," *Brain Communications*, 3 (4), 2021. doi:10.1093/braincomms/fcab248

3. A Shanker, **JH Abel**, G Schamberg, and EN Brown, "Etiology of burst suppression EEG patterns," *Frontiers in Psychology*, 12 (2207), 2021. doi: 10.3389/fpsyg.2021.673529.

4. **JH Abel**†, MA Badgeley†, B Meschede-Krasa, G Schamberg, IC Garwood, K Lecamwasam, S Chakravarty, DW Zhou, M Keating, PL Purdon, and EN Brown, "Machine learning of EEG spectra classifies unconscious states during propofol-induced anesthesia," *PLOS ONE*, 16 (5), 2021. doi: 10.1371/journal.pone.0246165

5. Y Shan, **JH Abel**, Y Li, M Izumo, KH Cox, B Jeong, S-H Yoo DP Olson, FJ Doyle III, and JS Takahashi, "Dual-color single-cell imaging of the suprachiasmatic nucleus reveals a circadian role in network synchrony," *Neuron* 108 (1), 2020. doi: j.neuron.2020.07.012

6. F Rijo-Ferreira, VA Acosta-Rodriguez†, **JH Abel**†, I Kornblum, I Bento, G Kilaru, EB Klerman, MM Mota, and JS Takahashi, "The malaria parasite has an intrinsic clock," *Science* 368 (6492), 2020. doi: 10.1126/science.aba2658

7. **JH Abel**, K Lecamwasam, MA St. Hilaire, and EB Klerman, "Recent advances in modeling sleep: from the clinic to society and disease," *Current Opinion in Physiology* 15, 2020. doi: 10.1016/j.cophys.2019.12.001

8. **JH Abel**, A Chakrabarty, EB Klerman, and FJ Doyle III, "Pharmaceutical-based entrainment of circadian phase via nonlinear model predictive control," *Automatica* 100, 2019. doi: 10.1016/j.automatica.2018.11.012

9. C Mazuski, **JH Abel**, S Chen, T Hermanstyne, FJ Doyle III, and ED Herzog, "Entrainment of circadian

rhythms depends on firing rates and neuropeptide release of VIP SCN neurons," *Neuron* 99 (3), 2018. doi: 10.1016/j.neuron.2018.06.029

10. V Carmona-Alcocer, **JH Abel**, TC Sun, LR Petzold, FJ Doyle III, CL Simms, and ED Herzog, "Ontogeny of circadian rhythms and synchrony in the suprachiasmatic nucleus," *Journal of Neuroscience* 38 (6), 2018. doi: 10.1523/jneurosci.2006-17.2017

11. **JH Abel**†, B Drawert†, A Hellander, and LR Petzold, "GillesPy: a Python package for stochastic model building and simulation," *IEEE Life Sciences Letters* 2 (3), 2017. doi: 10.1109/lls.2017.2652448

12. **JH Abel** and FJ Doyle III, "A systems theoretic approach to analysis and control of mammalian circadian dynamics," *Chemical Engineering Research and Design* 116, 2016. doi: 10.1016/j.cherd.2016.09.033

13. S Jung, **JH Abel**, J Starger, and H Yi, "Porosity-tuned chitosan-polyacrylamide hydrogel microspheres for improved protein conjugation," *Biomacromolecules* 17 (7), 2016. doi:10.1021/acs.biomac.6b00582

14. **JH Abel**†, K Meeker†, D Granados-Fuentes, PC St. John, T Wang, BB Bales, FJ Doyle III, ED Herzog, and LR Petzold, "Functional network inference of the suprachiasmatic nucleus," *Proceedings of the National Academy of Sciences* 113 (16), 2016. doi: 10.1073/pnas.1521178113

15. E Kang, S Jung, **JH Abel**, A Pine, and H Yi, "Shape-encoded chitosan-polyacrylamide hybrid hydrogel microparticles with controlled macroporous structures via replica molding for programmable biomacromolecular conjugation," *Langmuir* 32 (21), 2016. doi: 10.1021/acs.langmuir.5b04653

16. **JH Abel**, LA Widmer, PC St. John, J Stelling, and FJ Doyle III, "A coupled stochastic model explains differences in Cry knockout behavior," *IEEE Life Sciences Letters* 1 (1), 2015. doi: 10.1109/lls.2015.2439498

17. PC St. John, SR Taylor, **JH Abel**, and FJ Doyle III, "Amplitude metrics for cellular circadian bioluminescence reporters," *Biophysical Journal* 107 (11), 2014. doi: j.bpj.2014.10.026

Peer-reviewed conference proceedings

1. **JH Abel**, MA Badgeley, TE Baum, S Chakravarty, PL Purdon, and EN Brown, "Constructing a control-ready model of EEG signal during general anesthesia in humans," *Proceedings of the 21st IFAC World Congress*, July 2020. doi: 10.1016/j.ifacol.2020.12.243

2. AS Waite†, S Chakravarty†, **JH Abel**, EN Brown, "A simulation-based comparative analysis of PID and LQG control for closed-loop anesthesia delivery," in press for *Proceedings of the 21st IFAC World Congress*, July 2020. doi: 10.1016/j.ifacol.2020.12.369

3. **JH Abel**, A Chakrabarty, and FJ Doyle III, "Nonlinear model predictive control for circadian entrainment using small-molecule pharmaceuticals," *Proceedings of the 20th IFAC World Congress*, July 2017. doi: 10.1016/j.ifacol.2017.08.1596

Book chapters

1. **JH Abel**, A Chakrabarty, and FJ Doyle III, "Controlling time: nonlinear model predictive control for populations of circadian oscillators," in *Emerging Applications of Control and System Theory*, R Tempo, S Yurkovich, P Misra Eds. New York, NY: Springer Publishing, 2018. ISBN: 978-3-319-67068-3

2. B Drawert, K Sanft, **JH Abel**, S Hellander, A Pourzanjani, A Hellander, and LR Petzold, "Simulation of well-mixed and spatially inhomogeneous biochemical systems," in *Quantitative Biology: Theory, Computational Methods, and Models*, B Munsky, W Hlavacek, L Tsimring, Eds. Cambridge, MA: The MIT Press, 2018. ISBN: 978-0-262-03808-9

Patents and patent applications

1. H Yi, S Jung, and **JH Abel** "Macroporous chitosan-polyacrylamide hydrogel microspheres and preparation thereof," US Patent App. 16/311,063, published 2019.

2. H Yi, E Kang, S Jung, and **JH Abel**, "Fabrication of macroporous polymeric hydrogel microparticles," US Patent App. 16/090,453, published 2019.

Technical conference talks (presented only, posters excluded)

1. **JH Abel**, MA Badgeley, TE Baum, S Chakravarty, PL Purdon, and EN Brown, "Constructing a control-ready model of EEG signal during general anesthesia in humans," presented at 21st IFAC World Congress, July 2020. (contributed talk, proceedings listed above)

2. **JH Abel**, Y Shan, J Correa-Menendez, Y Li, M Izumo, and JS Takahashi, "Statistical models for multimodal long-duration circadian recordings" presented at Meeting of the Society for Research on Biological Rhythms (SRBR 2020), Online due to COVID, May 2020. (contributed talk)

3. **JH Abel**, A Asgari-Targhi, EB Klerman, and FJ Doyle III, "Designing a critical resetting protocol for achieving large phase shifts in humans," presented at Meeting of the Society for Research on Biological Rhythms (SRBR 2018), Amelia Island, Florida, USA, May 2018. (contributed talk)

4. **JH Abel**, A Chakrabarty, and FJ Doyle III, "Nonlinear model predictive control for circadian entrainment using small-molecule pharmaceuticals," presented at 20th IFAC World Congress, Toulouse, France, July 2017. (contributed talk, proceedings listed above)

5. **JH Abel**, "Control of the Mammalian Circadian Oscillator," presented at International School and Conference on Network Science (NetSci) 2017, Indianapolis, Indiana, USA, June 2017. (invited talk)

6. **JH Abel** and FJ Doyle III, "Identifying circadian drug targets for maintained oscillatory precision," presented at 2016 Meeting of the American Institute of Chemical Engineers (AIChE 2016), San Francisco, California, USA, November 2016. (contributed talk)

7. **JH Abel**, K Meeker, D Granados-Fuentes, PC St. John, T Wang, BB Bales, ED Herzog, LR Petzold, and FJ Doyle III, "Inferring the functional resynchronization network in the suprachiasmatic nucleus," presented at Meeting of the Society for Research on Biological Rhythms (SRBR 2016), Palm Harbor, Florida, USA, May 2016. (contributed talk)

8. **JH Abel** and LR Petzold (jointly given). "The effects of stochasticity on circadian rhythms," presented at Lorentz Center Workshop on Human Circadian Rhythms, Leiden, Netherlands, July 2015. (invited talk)

Invited lectures

1. **JH Abel**, "Suprachiasmatic nucleus: a master circadian pacemaker in mammals," presented at MCB 186: Sleep and Circadian Clocks: From Biology to Public Health, Harvard University, February 2020.

2. **JH Abel**, "Circadian oscillation in the malaria parasite: from genes to models," presented at Scientific Staff Meeting of the Division of Sleep and Circadian Disorders, Brigham and Women's Hospital, November 2019.

3. **JH Abel**, "Suprachiasmatic nucleus: a master circadian pacemaker in mammals," presented at MCB 186: Sleep and Circadian Clocks: From Biology to Public Health, Harvard University, February 2019.

4. **JH Abel**, "Controlling circadian rhtyhms," presented at Chronobiology and the Brain Seminar Series, Harvard Medical School, February 2018.

5. **JH Abel**, "Suprachiasmatic nucleus: a master circadian pacemaker in mammals," presented at MCB 186: Sleep and Circadian Clocks: From Biology to Public Health, Harvard University, February 2018.

6. **JH Abel**, "Suprachiasmatic nucleus: a master circadian pacemaker in mammals," presented at MCB 186: Sleep and Circadian Clocks: From Biology to Public Health, Harvard University, February 2017.

7. **JH Abel**, "Modeling the Circadian Rhtythm," presented at CS 341: Systems Biology, Colby College, November 2015.

Teaching and Mentoring

Teaching

January 2020	*Introduction to Physiological Closed-Loop Control (HST S56)*, MIT Role: Instructor Taught 20-hour, 3-credit MIT course in control theory and its medical applications (in collaboration with three members of MIT NSRL). Approximately 20 graduate and undergraduate students.
Fall 2019	*Sleep (Gen Ed 1038)*, Harvard University Role: Teaching Fellow Instructors: Charles A. Czeisler, Frank A.J.L. Scheer
January 2019	*Introduction to Physiological Closed-Loop Control (HST S56)*, MIT Role: Instructor Taught 20-hour, 3-credit MIT course in control theory and its medical applications (in collaboration with four members of MIT NSRL). Approximately 20 graduate and undergraduate students.
Spring 2017	*Sleep and Circadian Clocks: Biology to Public Health (MCB 186)*, Harvard University Role: Teaching Fellow Instructors: Charles A. Czeisler, Frank A.J.L. Scheer
Fall 2014	*Analytical Methods in Chemical Engineering (CHE 132A)*, UCSB Role: Teaching Assistant Instructor: Baron Peters

Undergraduate students mentored

Kimaya Lecamwasam	MIT/Wellesley Undergraduate Researcher Senior Thesis: Reinforcement Learning-Enabled Brain-Computer Interface Robotic Prosthetics	2018 - 2021
Matthew Keating	MIT Summer Researcher	2019
Shikha Sharma	Harvard University Summer Researcher	2016
David McBride	UC Santa Barbara Undergraduate	2015
Dustin Oakes	UC Santa Barbara HSAP	2015
Amanda Luan	UC Santa Barbara Undergraduate	2014
Jesse Starger	Tufts University Undergraduate	2013

Professional Activities

Peer review

NeuroImage Clinical, PLOS Computational Biology, BMC Bioinformatics, Anesthesia & Analgesia, Journal of Biological Rhythms, Journal of Clinical Monitoring and Computing, International Federation of Automatic Control (IFAC) World Congress, IEEE International Conference on Biomedical and Health Informatics, IEEE Engineering in Medicine and Biology Society (EMBS) Conference

Organizing and leadership

July 2020	Chair, Organizer of Invited Session "Precision Medicine Enabled by Automatic Control" (with Lindsey Brown) at International Federation of Automatic Control (IFAC) World Congress
July 2017	Chair, Organizer of Invited Session "Optimal Control and Optimization of Biological Systems" (with Steffen Waldherr) at International Federation of Automatic Control (IFAC) World Congress

Current as of: April 2, 2022