Andrew H. Song, Ph.D.

asong@bwh.harvard.edu - Website - Linkedin - Scholar

EDUCATION

Massachusetts Institute of Technology **Boston, MA, USA**

Ph.D. in Electrical Engineering and Computer Science *Sept. 2016 - Feb. 2022*

- *Thesis*: Generative models for neural time series with structured domain priors
- *Thesis Advisors*: Professors Emery N. Brown, Demba Ba

Massachusetts Institute of Technology **Boston, MA, USA**

B.S. & M.Eng. in Electrical Engineering and Computer Science (Co-terminal) *Sept. 2009 - Jun. 2016*

- Took two years of voluntary leave for military service in South Korean military and UN peacekeeping force (2011 - 2012).

WORK EXPERIENCE

Postdoctoral Fellow

Brigham and Women's Hospital/Harvard Medical School *Jan. 2022 -*

- Current research projects include (1) 3D computational pathology and (2) Multimodal deep learning in computational pathology
- *Mentor*: Professor Faisal Mahmood

Applied Scientist Intern

Amazon - AWS Audio Machine Learning/Digital Signal Processing team *June 2019 - Aug. 2019*

- Worked on designing/implementing a neural network architecture to denoise noisy multi-channel audio data, inspired by classical beamforming application.

Platform Infrastructure Software Engineer Intern

Akamai *June 2014 - Aug. 2014*

- Created an internal platform for employees to analyze and visualize the internet traffic data across the world.

Communication Specialist, English Interpreter, Sergeant

UN Peacekeeping force in Lebanon & South Korean Military *Jan. 2011 - Oct. 2012*

- Helped maintain peace and suppress terrorist attacks in unstable areas of Lebanon.
- Worked as an interpreter between the United Nations HQ and the Korean army HQ.

PUBLICATIONS

(*): Co-first authorship (+): Co-second authorship (†): Co-senior authorship

Selected Publications

- **Andrew H. Song**, Mane Williams[+], Drew F.K. Williamson[+], Sarah S.L. Chow, ..., Lawrence D. True, Anil V. Parwani, Jonathan T.C. Liu[†], and Faisal Mahmood[†], **Analysis of 3D pathology samples using weakly supervised AI**, *Cell*, 2024

  [NIH / NIBIB science highlight] [MGB press release] [Video] [Blog]

- **Andrew H. Song**, Richard Chen, Guillaume Jaume, Anurag Vaidya, Alexander S. Baras, and Faisal Mahmood, **Multimodal Prototyping for cancer survival prediction**, *ICML*, 2024

- **Andrew H. Song***, Richard Chen*, Tong Ding, Drew F.K. Williamson, Guillaume Jaume, and Faisal Mahmood, **Morphological Prototyping for Unsupervised Slide Representation Learning in Computational Pathology**, *CVPR*, 2024

- Anurag Vaidya*, Richard Chen*, Drew F.K. Williamson*, **Andrew H. Song**, ..., and Faisal Mahmood, **Demographic bias in misdiagnosis by computational pathology models**, *Nature Medicine*, 2024

- Bahareh Tolooshams*, **Andrew H. Song***, Simona Temereanca, and Demba Ba, **Convolutional dictionary learning based auto-encoders for natural exponential-family distributions**, *ICML*, 2020

Journal

- Tong Ding*, Sophia Wagner*, **Andrew H. Song***, Richard J. Chen*, ..., Long Phi Le†, and Faisal Mahmood†, **Multimodal Whole Slide Foundation Model for Pathology**, *Nature Medicine (In Press)*, 2025
- **Andrew H. Song**, Mane Williams+, Drew F.K. Williamson+, Sarah S.L. Chow, ..., Lawrence D. True, Anil V. Parwani, Jonathan T.C. Liu†, and Faisal Mahmood†, **Analysis of 3D pathology samples using weakly supervised AI**, *Cell*, 2024

  [NIH / NIBIB science highlight] [MGB press release] [Video] [Blog]
- Anurag Vaidya*, Richard Chen*, Drew F.K. Williamson*, **Andrew H. Song**, ..., and Faisal Mahmood, **Demographic bias in misdiagnosis by computational pathology models**, *Nature Medicine*, 2024
- Richard Chen*, Tong Ding*, Ming Y. Lu*, Drew F.K. Williamson*, Guillaume Jaume, **Andrew H. Song**, ..., and Faisal Mahmood, **Towards a general-purpose foundation model for computational pathology**, *Nature Medicine*, 2024
- **Andrew H. Song***, Guillaume Jaume*, Drew F.K. Williamson, Ming Y. Liu, Anurag Vaidya, Tiffany R. Miller, and Faisal Mahmood, **Artificial intelligence for digital and computational pathology**, *Nature Reviews Bioengineering*, 2023
- Alexander Lin, **Andrew H. Song**, Berkin Bilgic, and Demba Ba, **Covariance-Free Sparse Bayesian Learning**, *IEEE Transactions on Signal Processing*, 2022
- **Andrew H. Song***, Seong-eun Kim*, and Emery N. Brown, **Adaptive State-space Multitaper Spectral Estimation**, *IEEE Signal Processing Letters*, 2022
- **Andrew H. Song**, Bahareh Tolooshams, and Demba Ba, **Gaussian Process Convolutional Dictionary Learning**, *IEEE Signal Processing Letters*, 2022
- **Andrew H. Song**, Francisco Flores, and Demba Ba, **Convolutional dictionary learning with grid refinement**, *IEEE Transactions on Signal Processing*, 2020
- **Andrew H. Song**, Aaron Kucyi, Vitaly Napadow, Emery N. Brown, Marco L. Loggia, and Oluwaseun Akeju, **Pharmacological Modulation of Noradrenergic Arousal Circuitry Disrupts Functional Connectivity of Locus Ceruleus in Humans**, *Journal of Neuroscience*, 2017
- Oluwaseun Akeju, Allison E. Hamilos, **Andrew H. Song**, Kara J. Pavone, Patrick L. Purdon, and Emery N. Brown, **GABAA circuit mechanisms are associated with ether anesthesia-induced unconsciousness**, *Clinical Neurophysiology*, 2016
- Oluwaseun Akeju, **Andrew H. Song**, Allison E. Hamilos, Kara J. Pavone, Francisco J. Flores, Emery N. Brown, and Patrick L. Purdon, **Electroencephalogram signatures of ketamine anesthesia-induced unconsciousness**, *Clinical Neurophysiology*, 2016
- Ignacio Arnaldo, Kalyan Veeramachaneni, **Andrew H. Song**, Una-May O'Reilly, **Bring your own learner: A cloud-based, data-parallel commons for machine learning**, *IEEE Computational Intelligence Magazine*, 2015

Conference

- Daniel Shao, Richard Chen, **Andrew H. Song**, Joel Runevic, Ming Y. Lu, Tong Ding, and Faisal Mahmood, **Do Multiple Instance Learning Models Transfer?**, *ICML*, 2025
- **Andrew H. Song**, Richard Chen, Guillaume Jaume, Anurag Vaidya, Alexander S. Baras, and Faisal Mahmood, **Multimodal Prototyping for cancer survival prediction**, *ICML*, 2024
- **Andrew H. Song***, Richard Chen*, Tong Ding, Drew F.K. Williamson, Guillaume Jaume, and Faisal Mahmood, **Morphological Prototyping for Unsupervised Slide Representation Learning in Computational Pathology**, *CVPR*, 2024
- Gan Gao*, **Andrew H Song***, ..., Faisal Mahmood, and Jonathan T.C Liu, **Triage of 3D pathology data via 2.5D multiple-instance learning to guide pathologist assessments**, *CVPR CVMI workshop*, 2024
- Guillaume Jaume*, Paul Doucet*, **Andrew H. Song**, ..., and Faisal Mahmood, **HEST-1k: A Dataset for Spatial Transcriptomics and Histology Image Analysis**, *NeurIPS*, 2024
- Guillaume Jaume*, Anurag Vaidya*, Andrew Zhang+, **Andrew H. Song**+, ..., Long Phi Le, and Faisal Mahmood, **Multistain Pretraining for Slide Representation Learning in Pathology**, *ECCV*, 2024

- Guillaume Jaume*, Lukas Oldenburg*, Anurag Vaidya, Richard J. Chen, Drew F.K. Williamson, Thomas Peeters, **Andrew H. Song**, and Faisal Mahmood, **Transcriptomics-guided Slide Representation Learning in Computational Pathology**, *CVPR*, 2024
- Iain Carmichael*, **Andrew H. Song***, Richard Chen, Drew F.K. Williamson, Tiffany Chen, and Faisal Mahmood, **Incorporating intratumoral heterogeneity into weakly-supervised deep learning models via variance pooling**, *MICCAI*, 2022
- Alexander Lin, **Andrew H. Song**, Berkin Bilgic, and Demba Ba, **High-dimensional Sparse Bayesian Learning without Covariance Matrices**, *IEEE ICASSP*, 2022
- Alexander Lin, **Andrew H. Song**, and Demba Ba, **Mixture Model Auto-encoders : Deep Clustering through Dictionary Learning**, *IEEE ICASSP*, 2022
- **Andrew H. Song**, Demba Ba, and Emery N. Brown, **PLSO: A generative framework for decomposing nonstationary timeseries into piecewise stationary oscillatory components**, *UAI*, 2021
- Bahareh Tolooshams*, **Andrew H. Song***, Simona Temereanca, and Demba Ba, **Convolutional dictionary learning based auto-encoders for natural exponential-family distributions**, *ICML*, 2020
- Bahareh Tolooshams, Ritwik Giri, **Andrew H. Song**, Umut Isik, and Arvindh Krishnaswamy, **Channel-attention dense u-net for multichannel speech enhancement**, *ICASSP*, 2020
- **Andrew H Song***, Leon Chlon*, Hugo Soulat, John Tauber, Sandya Subramanian, Demba Ba, and Michael J Prerau, **Multitaper Infinite Hidden Markov Model for EEG**, *IEEE EMBC*, 2019
- **Andrew H. Song***, Sourish Chakravarty*, and Emery N. Brown, **A smoother state space multitaper spectrogram**, *IEEE EMBC*, 2018

Comments & Workshops

- Guillaume Jaume*, **Andrew H. Song***, and Faisal Mahmood, **Integrating Context for Superior Cancer Prognosis**, *Nature Biomedical Engineering*, 2022
- **Andrew H. Song**, Drew F.K. Williamson, and Faisal Mahmood, **Investigating Morphologic Correlates of Driver Gene Mutation Heterogeneity via Deep Learning**, *Cancer Research*, 2022

In preparation & Submitted

- Gan Gao, Renao Yan+, **Andrew H. Song**+, Huai-Ching Hsieh, ..., Jonathan T.C. Liu, **Deep-learning triage of 3D pathology datasets for comprehensive and efficient pathologist assessments**, *Submitted*, 2025
- Muhammad Shaban*, Yuzhou Chang*, Huaying Qiu+, Yao Yu Yeo+, **Andrew H. Song**+, Guillaume Jaume+, ..., Sizun Jiang†, Faisal Mahmood†, **A Foundation Model for Spatial Proteomics**, *Submitted*, 2025
- Cristina Almagro-Pérez*, **Andrew H. Song***, ..., and Faisal Mahmood, **AI-driven 3D Spatial Transcriptomics**, *Submitted*, 2025
- Anurag Vaidya*, Andrew Zhang*, Guillaume Jaume*, **Andrew H. Song**+, ..., Long Phi Le†, and Faisal Mahmood†, **Molecular-driven Foundation Model for Oncologic Pathology**, *In Revision at Nature Cancer*, 2025
- Luca L. Weishaupt*, Sharifa Sahai*, Andrew Zhang, **Andrew H. Song**, ..., Faisal Mahmood, **Real-time human-in-the-loop AI-driven measurement of the glomerular basement membrane**, *Submitted*, 2025
- Daniel Shao*, Sahar Hosseini*, **Andrew H. Song**, ..., Deepa T. Patil† and Faisal Mahmood†, **Multistain Transformer Predicts Progression to Advanced Barrett's Esophagus-Related Neoplasia**, *Submitted*, 2025
- Guillaume Jaume, Simone De Brot, **Andrew H. Song**, ..., and Faisal Mahmood, **Towards a Foundation Model for Preclinical Drug Safety Assessment**, *In Revision at Nature Biomedical Engineering*, 2024
- Guillaume Jaume*, Thomas Peeters*, **Andrew H. Song**, ..., and Faisal Mahmood, **AI-driven Discovery of Morphomolecular Signatures in Toxicology**, *Submitted*, 2024

PATENTS

- Cristina Almagro-Pérez, Andrew H. Song and Faisal Mahmood, **AI-driven 3D spatial transcriptomics**, *patent pending*, 2025
- Andrew H. Song and Faisal Mahmood, **Deep learning-based assessment of 3D pathology volumes at scale**, *patent pending*, 2024

INVITED TALKS

Integration of 3D pathology into oncologic workflow — **S.Korea**
Yonsei University College of Medicine Radiation Oncology seminar — *Aug. 2025*

Multi-dimensional pathology for personalized treatment — **S.Korea**
22nd Avison Biomedical Symposium — *Aug. 2025*

AI-driven multimodal pathology — **USA**
MD Anderson Imaging Physics & Translational Molecular Pathology Seminar — *June 2025*

Multi-dimensional and multi-modal pathology for improving patient prognosis — **USA**
MGH Molecular Pathology Seminar — *May 2025*

AI-enabled 3D pathology for improved patient prognosis — **USA**
Massachusetts Society of Pathologists & New England Society of Pathologists Joint Meeting — *Apr. 2025*

Dinner with Data: The AI Revolution in 2D and 3D Pathology — **USA**
United States and Canadian Academy of Pathology & Alpenglow dinner presentation — *Mar. 2025*

AI-driven clinical outcome prediction with multi-dimensional human tissue images — **USA**
Penn Medicine Research Seminar — *Mar. 2025*

When AI meets pathology – Harnessing AI for improved patient care — **USA**
MGH Clinical & Translational Epidemiology Unit Research Seminar — *Mar. 2025*

Unsupervised whole slide representation learning in pathology — **USA**
Abbvie CVRT Imaging Seminar — *Mar. 2025*

Taming large-scale pathology data for cancer clinical outcome prediction — **USA**
Johns Hopkins University Electrical and Computer Engineering Department Seminar — *Nov. 2024*

3D computational pathology — **S.Korea**
1st Annual Congress of the Asian Society of Digital Pathology — *Oct. 2024*

AI-driven 3D computational pathology — **USA**
3D Spatial Summit @ Alpenglow Biosciences — *Oct. 2024*

3D computational pathology — **USA**
The NRG Oncology Summer meeting 2024 — *Jul. 2024*

A Tour of 2D and 3D computational pathology — **USA**
AI×Med Seminar @ Center for Advanced Medical Computing and Analysis, MGH — *Jul. 2024*

3D computational pathology: The present and the future — **USA**
Charles River Laboratories — *Jun. 2024*

AI-driven efficient patient prognosis based on 3D pathology samples — **USA**
AI in Pathology seminar @ University of California — *May 2024*

3D computational pathology: Towards enhanced patient prognostication — **USA**
Advanced Biomedical Computation (ABC) seminar @ Harvard Medical School — *Mar. 2024*

A Tour of 2D and 3D computational pathology — **S.Korea**
Electrical Engineering Colloquium @ KAIST — *Mar. 2024*

A Tour of 2D and 3D computational pathology — **S.Korea**
Emerging Technology in Electrical and Computer Engineering Talks @ Seoul National University — *Mar. 2024*

AI-driven efficient patient prognosis based on 3D pathology samples — **UK**
Computational Pathology journal club @ AstraZeneca — *Dec. 2023*

AI-driven efficient patient prognosis based on 3D pathology samples — **UK**
TIA Centre seminar series @ Tissue Imaging Analysis Centre, University of Warwick — *Dec. 2023*

AI-driven efficient patient prognosis based on 3D pathology samples — **USA**
NCI Cancer Systems Biology Consortium @ National Cancer Institute — *Nov. 2023*

Capturing 3D histology from tissue samples for 3D computational analysis **UK**
X-ray in Microscopy in Life Sciences Hybrid Meeting @ ZEISS *Oct. 2023*

AI-driven efficient patient prognosis based on 3D pathology samples **USA**
3D Spatial Summit @ Alpenglow Biosciences *Sept. 2023*

AI-driven efficient patient prognosis based on 3D pathology samples **USA**
AI seminar @ PathAI *Aug. 2023*

Generative models for structured neural time series **S.Korea**
Data science seminar @ Seoul National University *Aug. 2021*

Neural signal processing with domain constraints **S.Korea**
AI Symposium @ KAIST *Aug. 2020*

Neural signal processing with domain constraints **S.Korea**
EE seminar @ KAIST *Mar. 2020*

SERVICE

Conference reviewer: **NeurIPS** 2024, 2025, **ICLR** 2024, 2025, **ICML** 2025, **UAI** 2023, IEEE **EMBC**, **COSYNE**
Journal reviewer: **Nature Biomedical Engineering**, **Communications Medicine**, **NPJ Digital Medicine**, **Genome Medicine**, **Cell Reports Methods**, **Modern Pathology**, **Scientific Reports**, IEEE **Transactions on Biomedical Engineering**, IEEE **Signal Processing Letters**

CITIZENSHIP

United States and South Korea (dual citizenship)

REFERENCES

Faisal Mahmood, Ph.D.
Associate Professor, Harvard Medical School, Boston *FaisalMahmood@bwh.harvard.edu*

Emery N. Brown, M.D., Ph.D.
Edward Hood Taplin Professor of Medical Engineering Professor, MIT, Boston *enb@neurostat.mit.edu*

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Chair of Anesthesiology, Mass General Brigham, Boston *oluwaseun.akeju@mgh.harvard.edu*

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