Tan Minh Nguyen

Contact information

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Academic appointments

University of California, Los Angeles, CA, USA 2020–present

- Post-doctoral Scholar in Mathematics
- Mentor: Professor Stanley J. Osher

Education

Rice University, Houston, Texas, USA

Ph.D. in Electrical and Computer Engineering, 2014–2020

- Advisor: Professor Richard G. Baraniuk
- Thesis: Momentum-based Methods for Training and Designing Deep Neural Networks

M.S. in Electrical and Computer Engineering, 2014–2016

- Advisor: Professor Richard G. Baraniuk
- Thesis: Bridging Theory and Practice in Deep Learning with the Deep Rendering Model

B.S. in Electrical and Computer Engineering, 2011–2014

Research Interests

My research focuses on the interplay of the interpretability, robustness, and efficiency of machine learning models from three principled approaches:

- Optimization (primal-dual frameworks for deep learning models, momentum-based neural networks, fast multipole transformers)
- Differential equations (Nesterov neural ordinary differential equations, graph neural diffusion)
- Statistical modeling (mixture and nonparametric kernel regression frameworks for transformers, deep generative models)

Journal Submissions

Tan M. Nguyen*, Nhat Ho*, Ankit B. Patel, Anima Anandkumar, Michael I. Jordan, Richard G. Baraniuk. "A Bayesian Perspective of Convolutional Neural Networks through a Deconvolutional Generative Model". *Under review, Journal of Machine Learning Research.*

Tan M. Nguyen*, Tam Nguyen*, Long Bui, Hai Do, Dung Le, Hung Tran-The, Khuong Nguyen, Richard G. Baraniuk, Nhat Ho, Stanley J. Osher. "A Probabilistic Framework for Pruning Transformers via a Finite Admixture of Keys". *Under review, Transactions on Machine Learning Research (TMLR).*

Conference Submissions

Tan M. Nguyen*, Tam Nguyen*, Nhat Ho, Andrea Bertozzi, Richard G. Baraniuk, Stanley J. Osher. "A Primal-Dual Framework for Transformers and Neural Networks". *Under review, International Conference on Learning Representations (ICLR), 2023.*

Tan M. Nguyen*, Tho Tran*, Tam Nguyen, Minh Pham, Nhat Ho, Stanley J. Osher. "Transformers with Multiresolution Attention Heads". *Under review, International Conference on Learning Representations (ICLR), 2023.*

*: co-first author

Anh Do*, Duy Dinh*, **Tan M. Nguyen***, Khuong Nguyen, Stanley J. Osher, Nhat Ho. "Improving Generative Flow Networks with Path Regularization". *Under review, International Conference on Learning Representations (ICLR), 2023.*

Xing Han*, Tongzheng Ren*, **Tan M. Nguyen***, Khai Nguyen, Joydeep Ghosh, Nhat Ho. "Robustify Transformers with Robust Kernel Density Estimation". *Under review, International Conference on Learning Representations (ICLR), 2023.*

Khang Nguyen*, Nong Minh Hieu*, **Tan M. Nguyen**, Khuong Nguyen, Vinh Duc Nguyen. "DeepGRAND: Deep Graph Neural Diffusion". *Under review, International Conference on Learning Representations (ICLR), 2023.*

Khai Nguyen, Tongzheng Ren, Huy Nguyen, Litu Rout, **Tan M. Nguyen**, Nhat Ho. 'Hierarchical Sliced Wasserstein Distance". *Under review, International Conference on Learning Representations (ICLR), 2023.*

Journal Publications

Bao Wang*, **Tan M. Nguyen***, Andrea L. Bertozzi, Richard G. Baraniuk, Stanley J. Osher. "Scheduled Restart Momentum for Accelerated Stochastic Gradient Descent". *SIAM Journal on Imaging Sciences, 2022.*

Bao Wang, Hedi Xia, **Tan M. Nguyen**, Stanley J. Osher. "How Does Momentum Benefit Deep Neural Networks Architecture Design? A Few Case Studies". *Research in the Mathematical Sciences, 2022.*

Yue Wang, Jianghao Shen, Ting-Kuei Hu, Pengfei Xu, **Tan M. Nguyen**, Richard Baraniuk, Zhangyang Wang, Yingyan Lin. "Dual Dynamic Inference: Enabling More Efficient, Adaptive, and Controllable Deep Inference". *IEEE Journal of Selected Topics in Signal Processing, 2020.*

Conference Publications

Tan M. Nguyen*, Minh Pham*, Tam Nguyen, Khai Nguyen, Stanley J. Osher, Nhat Ho. "FourierFormer: Transformer Meets Generalized Fourier Integral Theorem". *Conference on Neural Information Processing Systems (NeurIPS), 2022.*

Tan M. Nguyen*, Tam Nguyen*, Hai Do, Khai Nguyen, Vishwanath Saragadam, Minh Pham, Khuong Nguyen, Nhat Ho, Stanley J. Osher. "Improving Transformer with an Admixture of Attention Heads". *Conference on Neural Information Processing Systems (NeurIPS), 2022.*

Nghia Nguyen*, **Tan M. Nguyen***, Huyen Vo, Stanley J. Osher, Thieu Vo. "Improving Neural Ordinary Differential Equations with Nesterov's Accelerated Gradient Method". *Conference on Neural Information Processing Systems (NeurIPS), 2022.*

Tam Nguyen*, **Tan M. Nguyen***, Dung Le, Khuong Nguyen, Anh Tran, Richard G. Baraniuk, Nhat Ho, Stanley J. Osher. "Improving Transformers with Probabilistic Attention Keys". *International Conference on Machine Learning (ICML), 2022.*

Matthew Thorpe*, **Tan M. Nguyen***, Hedi Xia*, Thomas Strohmer, Andrea Bertozzi, Stanley J. Osher, Bao Wang. "GRAND++: Graph Neural Diffusion with a Source Term". *International Conference on Learning Representations (ICLR), 2022.*

Tan M. Nguyen, Richard G. Baraniuk, Mike Kirby, Stanley J. Osher, Bao Wang. "Momentum Transformer: Closing the Performance Gap Between Self-attention and Its Linearization". *Mathematical and Scientific Machine Learning (MSML), 2022.*

Tan M. Nguyen, Animesh Garg, Richard G Baraniuk, Anima Anandkumar. "InfoCNF: An Ef-

ficient Conditional Continuous Normalizing Flow with Adaptive Solvers". *Asilomar Conference, 2022*.

Tan M. Nguyen, Vai Suliafu, Stanley J. Osher, Long Chen, Bao Wang. "FMMformer: Efficient and Flexible Transformer via Decomposed Near-field and Far-field Attention". *Conference on Neural Information Processing Systems (NeurIPS), 2021*.

Hedi Xia, Vai Suliafu, Hangjie Ji, **Tan M. Nguyen**, Andrea Bertozzi, Stanley J. Osher, Bao Wang. "Heavy Ball Neural Ordinary Differential Equations". *Conference on Neural Information Processing Systems (NeurIPS), 2021*.

Tan M. Nguyen, Richard G. Baraniuk, Andrea Bertozzi, Stanley J. Osher, Bao Wang. "MomentumRNN: Integrating Momentum into Recurrent Neural Networks". *Conference on Neural Information Processing Systems (NeurIPS), 2020*.

Yujia Huang, James Gornet, Sihui Dai, Zhiding Yu, **Tan M. Nguyen**, Doris Tsao, Anima Anandkumar. "Neural Networks with Recurrent Generative Feedback". *Conference on Neural Information Processing Systems (NeurIPS), 2020*.

Tan M. Nguyen*, Nhat Ho*, Ankit B. Patel, Anima Anandkumar, Michael I. Jordan, Richard G. Baraniuk. "Neural Rendering Model: Joint Generation and Prediction for Semi-Supervised Learning". *Deep Math Conference (DeepMath), 2019*. (Oral presentation)

Tan M. Nguyen, Wanjia Liu, Fabian Sinz, Richard G. Baraniuk, Andreas S. Tolias, Xaq Pitkow, Ankit B. Patel. "Towards a Cortically Inspired Deep Learning Model: Semi-Supervised Learning, Divisive Normalization, and Synaptic Pruning". *Conference on Cognitive Computational Neuroscience (CCN), 2017*.

Ankit B Patel, **Tan M. Nguyen**, Richard Baraniuk. "A Probabilistic Framework for Deep Learning". *Conference on Neural Information Processing Systems (NeurIPS), 2016*.

Papers on Application

Gavin D. Portwood, Peetak P. Mitra, Mateus Dias Ribeiro, **Tan M. Nguyen**, Balasubramanya T. Nadiga, Juan A. Saenz, Michael Chertkov, Animesh Garg, Anima Anandkumar, Andreas Dengel, Richard G. Baraniuk, David P. Schmidt. "Turbulence Forecasting via Neural ODE". *NeurIPS Workshop on Machine Learning and the Physical Sciences, 2019*.

Teaching

Summer 2022, Math 156 Machine Learning, UCLA.

Fall 2021, Probability & Statistics Course, FPT Software AI Residency, Vietnam.

Awarded Grant

PI, Toyota Research Institute Grant, *A Unified Framework for Building Large-Scale Language Models in Developing Countries: From Model and System to Data*, $100,000, November, 2022 - November, 2023

Workshop Organization

Integration of Deep Neural Models and Differential Equations at the International Conference on Learning Representations (ICLR), 2020.

Integration of Deep Learning Theories at the Conference on Neural Information Processing Systems (NeurIPS), 2018.

Honors and Awards

J. Tinsley Oden Visiting Fellowship, 2022

Computing Innovation Postdoctoral Fellowship (CIFellows), 2020–2023.

AWS Cloud Credits for Research, $50,000, September, 2018.

NSF Graduate Research Fellowship, 2016–2020.

Ford Foundation Fellowship Honorable Mention, 2016.

Neuroengineering IGERT: From Cells to Systems Fellowship, 2015 – 2017.

Texas Instruments Fellowship, 2014–2016. (Awarded to top incoming graduate students in the ECE department at Rice University)

Louis J. Walsh Scholarship in Engineering, 2013–2014. (Awarded to top undergraduate students in the ECE department at Rice University)

Gold Scholar on Coca-Cola's Community College Academic Team, 2011.

Invited Seminar Presentations

A Statistical Treatment of the Attention Mechanism in Transformers. *Analytics Center of Excellence (ACOE), IQVIA, Italy, 2022.*

Principled Models for Machine Learning. *Math Machine Learning Seminar, the Max Planck Institute for Mathematics in the Sciences and UCLA, USA, 2022.*

Principled Models for Machine Learning. *Applied Math Colloquium at UCLA, USA, 2022.*

Principled Models for Machine Learning. *Invited Talk , Department of Aerospace Engineering and Engineering Mechanics at UT Austin, USA, 2022.*

Momentum-based Methods for Training and Designing Deep Neural Networks. *VinAI Research, Vietnam, 2020.* (Invited talk)

Scheduled Restart Momentum for Accelerated Stochastic Gradient Descent. *Machine Learning Seminar, Rice University, USA, 2020.* (Invited talk)

Deep Generative Models for Geophysical Signal Disentanglement. *Geo-Mathematical Imaging Group (GMIG) Project Review Meeting, Rice University, USA, 2018.* (Invited talk)

Conference, Workshop Presentations

A Primal-Dual Framework for Transformers and Neural Networks. *Special Session on "Mathematics of Machine Learning", Canadian Mathematical Society Winter Meeting, 2022.* (Invited talk)

Transformer with Fourier Integral Attentions. *Deep Learning for Sequence Modeling Minisymposium, the SIAM Conference on Computational Science and Engineering (CSE), 2023.* (Invited talk)

Transformer with a Mixture of Gaussian Keys. *Geometry of Machine Learning Minisymposium, the 4th Annual Meeting of the SIAM Texas-Louisiana Section, 2021.* (Invited talk)

Momentum-Based and Fast Multipole Methods for Designing Deep Learning Models. *Mathematical Foundation of Deep Learning with the Applications to PDE Minisymposium, the 4th Annual Meeting of the SIAM Texas-Louisiana Section, 2021.* (Invited talk)

Brain-inspired Robust Vision Using Convolutional Neural Networks with Feedback. *NeurIPS NeuroAI Workshop, 2019.* (Poster)

Conditional Continuous Normalizing Flows for Physics-Inspired Learning. *NVIDIA Onsite Research*

Event, 2019. (Lightning Talk)

Neural Rendering Model: Rethinking Neural Networks from the Joint Generation and Prediction Perspective. *NeurIPS Workshop on Integration of Deep Learning Theories, 2018.* (Contributed talk)

EnergyNet: Energy-Efficient Dynamic Inference. *NeurIPS Workshop on Compact Deep Neural Network Representation with Industrial Applications, 2018.* (Poster)

Tremor Generative Adversarial Network (TremorGAN): Deep Generative Model Approach for Geophysical Signal Generation. *NeurIPS Workshop on Machine Learning for Geophysical and Geochemical Signals, 2018.* (Poster)

The Latent-Dependent Deep Rendering Model. *ICML Workshop on Theoretical Foundations and Applications of Deep Generative Models, 2018.* (Poster)

Mixed Reality Generative Adversarial Networks: Closing the Visual Gap between Synthetic and Real Images. *Amazon Graduate Research Symposium, 2017.* (Poster)

A Probabilistic Framework for Deep Learning. *Computational and System Neuroscience Conference (COSYNE), 2016.* (Poster)

Mentoring

Hedi Xia, Ph.D. student in the Mathematics Department at UCLA

Tam Nguyen, Resident at FPT Software AI. (Next: Interviewing for a Ph.D. position at Rice University)

Yujia Huang, Ph.D. student in the Computing + Mathematical Sciences Department at Caltech

Wanjia Liu, Master student in the Computer Science Department at Rice University. (Next: Google)

Si Hui Dai, Undergraduate student in the Computing + Mathematical Sciences Department at Caltech. (Next: Ph.D. at Princeton)

Ethan Perez, Undergraduate student in the Computer Science Department at Rice University. (Next: Ph.D. at NYU)

Professional services

Journal reviewing

- Journal of Machine Learning Research
- Transactions on Pattern Analysis and Machine Intelligence
- Transactions on Machine Learning Research
- Machine Learning with Applications
- Information and Inference
- IEEE Journal on Selected Areas in Information Theory
- Statistical Applications in Genetics and Molecular Biology

Conference reviewing

- International Conference on Machine Learning (ICML)
- Conference on Neural Information Processing Systems (NeurIPS)
- International Conference on Learning Representations (ICLR)
- AAAI Conference on Artificial Intelligence (AAAI)

- Asilomar Conference on Signals, Systems, and Computers

Other service

- Summer Undergraduate Research Fellowship Program at Caltech, Pasadena, California, *Project Mentor*
- Machine Learning Lunch at Rice University, Houston, Texas, *Organizer*
- Deep Learning Meeting at Rice University, Houston, Texas, *Organizer*

MEMBERSHIP

Institute of Electrical and Electronics Engineers (IEEE)

REFERENCES

Professor Stanley J. Osher
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Director of Special Projects, Institute for Pure and Applied Mathematics (IPAM)
University of California, Los Angeles
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Distinguished Professor of Mathematics and Mechanical and Aerospace Engineering
Betsy Wood Knapp Chair for Innovation and Creativity
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