# Sam D. Buchanan

*Research Assistant Professor*
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## Professional Experience

2022–  **Research Assistant Professor**
Toyota Technological Institute at Chicago

## Education

2022  **PhD**, **Electrical Engineering**
Columbia University in the City of New York
ADVISOR: John Wright
THESIS: Deep Networks Through the Lens of Low-Dimensional Structure: Towards Mathematical and Computational Principles for Nonlinear Data

2017  **MS**, **Electrical Engineering**
Columbia University in the City of New York

2014  **BS**, **Electrical Engineering** (with distinction)
University of Kansas

## Awards and Honors

2022  Eli Jury Award, Columbia University Electrical Engineering Department
2017  NDSEG Fellow, US Department of Defense (award rate: $\approx 7\%$)
2016  Tesla Scholar, Columbia Univeristy Electrical Engineering Department

## Publications

### Preprint

2023  Y. Yu*, T. Chu*, S. Tong, Z. Wu, D. Pai, S. Buchanan, and Y. Ma, "Emergence of segmentation with minimalistic white-box transformers," Aug. 2023. arXiv: 2308.16271 [cs.CV]

Y. Yu, S. Buchanan, D. Pai, T. Chu, Z. Wu, S. Tong, B. D. Haeffele, and Y. Ma, "White-box transformers via sparse rate reduction," Jun. 2023. arXiv: 2306.01129 [cs.LG]

2022    S. Buchanan, J. Yan, E. Haber, and J. Wright, "Resource-efficient invariant networks: Exponential gains by unrolled optimization," Mar. 2022. arXiv: 2203.05006 [cs.CV].

## Conference

2023    B. Yi, W. Zeng, S. Buchanan, and Y. Ma, "Canonical factors for hybrid neural fields," *International Conference on Computer Vision (ICCV)*, Oct. 2023

2021    T. Wang, S. Buchanan, D. Gilboa, and J. Wright, "Deep networks provably classify data on curves," *Advances in Neural Information Processing Systems*, vol. 34, Curran Associates, Inc., 2021, pp. 28 940–28 953.
S. Buchanan, D. Gilboa, and J. Wright, "Deep networks and the multiple manifold problem," *International Conference on Learning Representations*, 2021.

2019    D. Gilboa, S. Buchanan, and J. Wright, "Efficient dictionary learning with gradient descent," *Proceedings of the 36th International Conference on Machine Learning*, ser. Proceedings of Machine Learning Research, vol. 97, PMLR, 2019, pp. 2252–2259.

2018    S. Buchanan, T. Haque, P. Kinget, and J. Wright, "Efficient model-free learning to overcome hardware nonidealities in analog-to-information converters," *2018 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, Apr. 2018, pp. 3574–3578.

# Invited Talks

2022    *"Deep Networks and the Multiple Manifold Problem"*, U Michigan CSP Seminar, December.
*"Deep Networks and the Multiple Manifold Problem"*, SIAM MDS 2022 Minisymposium "The Role of Data Geometry in High-Dimensional Learning", September.
*"Deep Networks Through the Lens of Low-Dimensional Structure"*, Talks at TTIC, April.
*"Deep Networks Through the Lens of Low-Dimensional Structure"*, Johns Hopkins MINDS Seminar, March.

# Teaching

2023    **Tutorial**, Learning Nonlinear and Deep Low-Dimensional Representations from High-Dimensional Data: From Theory to Practice
*ICASSP 2023 Short Course*, June 2023
**Tutorial**, Learning Low-Dimensional Structure via Deep Networks
*SLowDNN Workshop 2023 Tutorial*, January 2023

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| 2022 | **Tutorial**, Low-Dimensional Models for High-Dimensional Data: From Linear to Nonlinear, Convex to Nonconvex, and Shallow to Deep<br>*ICASSP 2022 Short Course*, May 2022 |
| 2018, 2019 | **Teaching Assistant**, Sparse Representation and High-Dimensional Geometry (ELEN 6886)<br>*Columbia University*<br>Developed a suite of theoretical and computational exercises for the textbook High-Dimensional Data Analysis with Low-Dimensional Models: Principles, Computation, and Applications. |

# Professional Service

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| 2023 | **Web Chair**, Inaugural Conference on Parsimony and Learning (CPAL)<br>Hong Kong University, Hong Kong<br>**Organizer**, Collaboration on the Theoretical Foundations of Deep Learning Annual Meeting<br>TTIC, Chicago<br>**Tutorial Chair**, 3rd Workshop on Seeking Low-Dimensionality in Deep Neural Networks<br>MBZUAI, Abu Dhabi |

## Journal Reviewing

TPAMI, TMLR

## Conference Reviewing

CVPR 19\*, 21\*; ICLR 22\*, 23, 24; ICML 21\*, 22, 23; NeurIPS 20\*, 21, 22\*, 23

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\*denotes a designation of reviewer quality ("outstanding reviewer", etc.)