廖 振宇

📱 *131-6415-1928*
✉ *zhenyu_liao@hust.edu.cn*
🌐 *https://zhenyu-liao.github.io/*
男，中共党员

工作经历

2021-至今	**副研究员**, 华中科技大学, 电子信息与通信学院
2020-2021	**博士后研究员**, 加州大学伯克利分校, 统计系, 合作导师：Michael Mahoney 教授

教育经历

2016-2019	**博士**, 巴黎萨克雷大学, 数学与计算机, 合作导师：Romain Couillet 教授
2014-2016	**硕士**, 巴黎萨克雷大学, 信号与图像处理, 合作导师：Romain Couillet 教授
2010-2014	**本科**, 华中科技大学, 光电信息工程

科研获奖

2025	加拿大 CRM-Simons 访问教授，蒙特利尔大学 Centre de recherches mathématiques (CRM)
2025	MATRIX-Simons Travel Grant, MATRIX, Creswick, 澳大利亚
2024	法国 ANR-LabEx-CIMI 访问教授，图卢兹第三大学 Centre International de Mathématiques et Informatique de Toulouse (CIMI)
2023	湖北省人才项目计划
2021	武汉市人才计划计划
2019	巴黎萨克雷大学 ED STIC 优秀博士论文
2016	巴黎萨克雷大学 Supélec Foundation Ph.D. Fellowship

学术专著

CUP	Romain Couillet, **Zhenyu Liao**. Random Matrix Methods for Machine Learning. *Cambridge University Press*. 2022. DOI: 10.1017/9781009128490. ISBN: 9781009123235.

部分代表论文

会议论文

ICLR 25	Xiaoyi Mai and **Zhenyu Liao**. The Breakdown of Gaussian Universality in Classification of High-dimensional Mixtures. *International Conference on Learning Representations*. 2025.
SIGMOD 25	Jiuqi Wei, Xiaodong Lee, **Zhenyu Liao**, Themis Palpanas, and Botao Peng. Subspace Collision: An Efficient and Accurate Framework for High-dimensional Approximate Nearest Neighbor Search. *Proc. ACM Manag. Data (SIGMOD)* **3**(1) (June 2025).
EUSIPCO 24	Wei Yang, Zhengyu Wang, Xiaoyi Mai, Zenan Ling, Robert C. Qiu, and **Zhenyu Liao**. Inconsistency of ESPRIT DoA Estimation for Large Arrays and a Correction via RMT. *IEEE 32nd European Signal Processing Conference*. Aug. 2024, pp.2722–2726.
ICML 24	Zenan Ling, Longbo Li, Zhanbo Feng, Yixuan Zhang, Feng Zhou, Robert C. Qiu, and **Zhenyu Liao**. Deep Equilibrium Models Are Almost Equivalent to Not-so-deep Explicit Models for High-dimensional Gaussian Mixtures. *Proceedings of the 41st International Conference on Machine Learning*. Vol. 235. PMLR, 2024, pp.30585–30609.
ISIT 24	Yi Song, Kai Wan, **Zhenyu Liao**, Hao Xu, Giuseppe Caire, and Shlomo Shamai. An Achievable and Analytic Solution to Information Bottleneck for Gaussian Mixtures. *IEEE International Symposium on Information Theory*. 2024.
NeurIPS 22	Lingyu Gu, Yongqi Du, Yuan Zhang, Di Xie, Shiliang Pu, Robert C. Qiu, and **Zhenyu Liao**, "Lossless" Compression of Deep Neural Networks: A High-dimensional Neural Tangent Kernel Approach. *Advances in Neural Information Processing Systems*. Vol. 35. 2022, pp.3774–3787.

ICLR 22 Hafiz Tiomoko Ali, **Zhenyu Liao**, and Romain Couillet. Random matrices in service of ML footprint: ternary random features with no performance loss. *The Tenth International Conference on Learning Representations*. 2022.

NeurIPS 21 **Zhenyu Liao** and Michael W. Mahoney. Hessian Eigenspectra of More Realistic Nonlinear Models. *Advances in Neural Information Processing Systems*. Vol. 34. 2021, pp.20104–20117.

COLT 21 Michal Derezinski, **Zhenyu Liao**, Edgar Dobriban, and Michael W Mahoney. Sparse sketches with small inversion bias. *Proceedings of Thirty Fourth Conference on Learning Theory*. Vol. 134. Proceedings of Machine Learning Research. PMLR, 15–19 Aug 2021, pp.1467–1510.

ICLR 21 **Zhenyu Liao**, Romain Couillet, and Michael W Mahoney. Sparse Quantized Spectral Clustering. *The Ninth International Conference on Learning Representations*. 2021.

AISTATS 21 Fanghui Liu, **Zhenyu Liao**, and Johan Suykens. Kernel Regression in High Dimension: Refined Analysis beyond Double Descent. *Proceedings of The 24th International Conference on Artificial Intelligence and Statistics*. Vol. 130. Proceedings of Machine Learning Research. PMLR, 13–15 Apr 2021, pp.649–657.

NeurIPS 20a **Zhenyu Liao**, Romain Couillet, and Michael W Mahoney. A random matrix analysis of random Fourier features: beyond the Gaussian kernel, a precise phase transition, and the corresponding double descent. *Advances in Neural Information Processing Systems*. Vol. 33. pp.13939–13950. 2020.

NeurIPS 20b Michal Derezinski, Feynman T Liang, **Zhenyu Liao**, and Michael W Mahoney. Precise expressions for random projections: Low-rank approximation and randomized Newton. *Advances in Neural Information Processing Systems*. Vol. 33. pp.18272–18283. 2020.

EUSIPCO 18 Romain Couillet, **Zhenyu Liao**, and Xiaoyi Mai. Classification Asymptotics in the Random Matrix Regime. *The 26th European Signal Processing Conference*. IEEE. Sept. 2018, pp.1875–1879.

ICASSP 19 Xiaoyi Mai, **Zhenyu Liao**, and Romain Couillet. A Large Scale Analysis of Logistic Regression: Asymptotic Performance and New Insights. *IEEE International Conference on Acoustics, Speech and Signal Processing*. IEEE. May 2019, pp.3357–3361.

ICML 18 **Zhenyu Liao**, and Romain Couillet. On the Spectrum of Random Features Maps of High Dimensional Data. *Proceedings of the 35th International Conference on Machine Learning*. Vol. 80. PMLR, July 2018, pp.3063–3071.

ICML 18 **Zhenyu Liao**, and Romain Couillet. The Dynamics of Learning: A Random Matrix Approach. *Proceedings of the 35th International Conference on Machine Learning*. Vol. 80. PMLR, July 2018, pp.3072–3081.

ICASSP 17 **Zhenyu Liao** and Romain Couillet. Random Matrices Meet Machine Learning: A Large Dimensional Analysis of LS-SVM. *IEEE International Conference on Acoustics, Speech and Signal Processing*. IEEE. Mar. 2017, pp.2397–2401.

期刊论文

TKDE 24 Zhanbo Feng, Yuanjie Wang, Jie Li, Fan Yang, Jiong Lou, Tiebin Mi, Robert. C. Qiu, **Zhenyu Liao**. Robust and Communication-Efficient Federated Domain Adaptation via Random Features. *IEEE Transactions on Knowledge and Data Engineering* **37**(3) (2025), 1411–1424.

PRA 23 Jingcheng Wang, Shaoliang Zhang, Jianming Cai, **Zhenyu Liao**, Christian Arenz, and Ralf Betzholz. Robustness of random-control quantum-state tomography. *Phys. Rev. A* **108** (2 2023), 022408.

MCRF 23 Yacine Chitour, **Zhenyu Liao**, and Romain Couillet. A geometric approach of gradient descent algorithms in linear neural networks. *Mathematical Control and Related Fields* **13**(3) (2023), 918–945.

JSTAT 21 **Zhenyu Liao**, Romain Couillet, and Michael W Mahoney. A random matrix analysis of random Fourier features: beyond the Gaussian kernel, a precise phase transition, and the corresponding double descent. *Journal of Statistical Mechanics: Theory and Experiment* **2021**(12) (Dec. 2021), 124006.

TSP 19 **Zhenyu Liao** and Romain Couillet. A Large Dimensional Analysis of Least Squares Support Vector Machines. *IEEE Transactions on Signal Processing* **67**(4) (Feb. 2019), 1065–1074.

AAP 18 Cosme Louart, **Zhenyu Liao**, and Romain Couillet. A Random Matrix Approach to Neural Networks. *The Annals of Applied Probability* **28**(2) (Apr. 2018), 1190–1248.

科研项目

2024-2026	广东省人工智能数理基础重点实验室开放基金：基于随机矩阵方法的 *Transformer* 模型泛化理论研究（OFA00003），10 万元，**主持**
2024-2026	华为拉格朗日数学与计算研究中心合作项目：*Algorithm and Theory of High-dimensional Dynamical Systems*（TC20240702035），80 万元，**主持**
2023-2025	国家自然科学基金青年科学基金项目：基于随机矩阵方法的神经网络模型剪枝基础理论研究（NSFC-62206101），30 万元，**主持**
2023-2025	华为技术有限公司校企合作项目：随机矩阵理论驱动的通信理论和算法研究（TC20231122043），59 万元，**主持**
2022-2025	国家自然科学基金"面向未来通信的数学基础（信息论）"专项项目：智能反射面辅助的新型无线通信数学理论与数学技术（NSFC-12141107），300 万元，核心成员
2021-2023	湖北省重点研发计划项目：新一代工业互联网网络关键技术研究（2021BAA037），100 万元，核心成员
2021-2022	中国计算机学会 CCF-海康威视斑头雁基金项目：基于随机矩阵和信息瓶颈理论的神经网络表达和压缩的研究（20210008），28 万元，**主持**
2021-2024	广西省重点研发计划项目：交通路网重要节点主动安全防控智能一体化成套技术研究与产业化（桂科 AB21196034），500 万元，核心成员
2018-2021	NSF Research Grant, *Combining Stochastics and Numerics for Improved Scalable Matrix Computations* (NSF-1815054)，500k 美元，核心成员
2018-2021	法国高等教育、研究与创新部：GSTATS-IDEX DataScience Chair，300k 欧元，核心成员
2015-2017	法国自然科学基金委：*Random Matrix Theory for Large Dimensional Graphs*（ANR-14-CE28-0006），300k 欧元，核心成员

教学改革项目

2024-2025	华中科技大学国家卓越工程师学院 2025 年"卓越工程师自主培养新范式"项目：产教融合卓越工程师国际化视野培养，5 万元，**主持**

科研服务

学会兼职	中国现场统计研究会随机矩阵理论与应用分会副秘书长，中国现场统计研究会大数据统计分会理事，中国通信学会短距无线通信委员会秘书
基金审稿人	欧洲研究理事会 ERC，加拿大自然科学与工程研究委员会 NSERC，中国国家自然科学基金委员会 NSFC，以色列科学基金会 ISF
国际会议领域主席	ICLR 2025, ICML 2025, IJCNN 2025.
国际期刊副编辑	Springer Statistics and Computing（2025 年至今）
国际会议审稿人	ICLR, ICML, NeurIPS, SODA, AISTATS, AAAI, ECAI, IEEE-ICASSP, IEEE-CAMSAP.
数学与数据科学期刊审稿人	SIAM Review (SIREV), Foundations of Computational Mathematics (FoCM), Physical Review X (PRX), IEEE Trans. on Signal Processing (IEEE-TSP), Springer Statistics and Computing (STCO), SIAM Journal on Scientific Computing (SISC), Random Matrices: Theory and Applications (RMTA), Latin American Journal of Probability and Mathematical Statistics (ALEA), Electronic Journal of Statistics (EJS).
机器学习和 AI 期刊审稿人	Journal of Machine Learning Research (JMLR), IEEE Trans. on Pattern Analysis and Machine Intelligence (IEEE-TPAMI), IEEE Trans. on Neural Networks and Learning Systems (IEEE-TNNLS), Transactions on Machine Learning Research (TMLR), Pattern Recognition (PR), Neural Processing Letters (NPL).

学术活动
- 2024 Random Matrix Theory and Application Conference, Jinlin, Changchun, 2025.
- 2024 LMCRC Workshop on Mathematical Information Science, Paris, France, 2024.
- **General co-chair** of 10th EAI International Conference on loT as a Service (EAI IoTaaS 2024), Wuhan, China, 2024.
- 华中科技大学-巴黎萨克雷大学2022 联合工作坊 "数据科学中的数学奥秘"
  - 吸引超过 **40 000** 名相关领域的科研人员、老师和同学参与
  - 回放链接: `https://www.bilibili.com/video/BV1G8411b7ir/`
- 1st Workshop in High-dimensional Learning Dynamics (HiLD) at ICML 2023, Honolulu, Hawaii.
  - 报告嘉宾: Sanjeev Arora, SueYeon Chung, Murat A. Erdogdu, Surya Ganguli, and Andrea Montanari.

推荐人

邱才明 华中科技大学电子信息与通信学院院长，IEEE Fellow。Email: caiming@hust.edu.cn

Michael Mahoney Associate Adjunct Professor at Department of Statistics, UC Berkeley, CA, USA. Director of the UC Berkeley FODA (Foundations of Data Analysis) Institute, Berkeley, CA, USA. Email: mmahoney@stat.berkeley.edu

Romain Couillet Full Professor at University Grenoble-Alps, France. Holder of the UGA MIAI LargeDATA Chair, University-Grenoble-Alps, France. Email: romain.couillet@gipsa-lab.grenoble-inp.fr