

# 廖振宇

## 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 (签证原因未成行)  
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

- ICML 25** Chengmei Niu, **Zhenyu Liao**, Zenan Ling, and Michael W. Mahoney. Fundamental Bias in Inverting Random Sampling Matrices with Application to Sub-sampled Newton. *Proceedings of the 42nd International Conference on Machine Learning*. PMLR, 2025.
- 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* **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.

☎ (+86)-131-6415-1928  
✉ [zhenyu\\_liao@hust.edu.cn](mailto:zhenyu_liao@hust.edu.cn)  
🌐 <https://zhenyu-liao.github.io/>  
男, 中共党员



- 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 Dereziński, **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 Dereziński, 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

- 2026-2029 国家自然科学基金面上项目：基于随机矩阵方法的 *Transformer* 大模型压缩：从缩放定律极限理论到动态自适应模型压缩方法 (NSFC-12571561)，44 万元，**主持**；Co-PI: Cosme Louart, SDS, 香港中文大学（深圳）
- 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，3 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，中国商业统计学会人工智能分会理事，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** ICML 2025, NeurIPS 2025, ICLR 2025-2026, AISTATS 2026, 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), Journal of Mathematical Physics, 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), Annals of Applied Probability (AAP), Electronic Journal of Statistics (EJS), AIMS Mathematics
- 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
- Special Session (together with Dirk Slock) on “Large-Dimensional Structures and Methods for Signal Processing, Communication, and Machine Learning” at 2026 IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2026), May 2026, Barcelona, Spain.
  - Random Matrix Theory and Application Conference (RMTA 2025), Jinlin, Changchun, 2025.
    - 组织委员会: Jeff Yao, Shurong Zheng, Jiang Hu and Dandan Jiang
  - **General co-chair** of 10th EAI International Conference on IoT 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
    - 组织委员会: Mihai Nica, Courtney Paquette, Elliot Paquette, Andrew Saxe, and René Vidal
    - 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](mailto: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](mailto: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](mailto:romain.couillet@gipsa-lab.grenoble-inp.fr)