Zhenyu Liao
Curriculum Vitae

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 Male, Chinese, born in 28/08/1992.

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Education

2019	**Ph.D.**	Statistics and Machine Learning	L2S, CentraleSupélec, University of Paris-Saclay, France.
2016	**M.Sc.**	Signal and Image Processing	University of Paris-Saclay, France.
2014	**B.Sc.**	Optical & Electronic Information	Huazhong university of Science and Technology, China.

Experiences

➤ 2021-now: **Research Associated Professor** at School of Electronic Information and Communications, Huazhong University of Science & Technology.

➤ 2020-2021: **Postdoctoral Scholar** at ICSI and Department of Statistics, University of California, Berkeley, hosted by Prof. Michael Mahoney.

Awards and prizes

➤ 2021: Recipient of the 2021 Wuhan Youth Talent, Wuhan, China.

➤ 2021: Recipient of East Lake Youth Talent Program Fellowship of Huazhong University of Science & Technology, Wuhan, China.

➤ 2019: 2nd prize of ED STIC Ph.D. Student Award of University Paris-Saclay, France.

➤ 2016: Recipient of the Supélec Foundation Ph.D. Fellowship, France.

Publications

Books

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

Papers in conference proceedings

1. 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. In: *Advances in Neural Information Processing Systems (NeurIPS)*. Vol. 35. 2022.

2. Hafiz Tiomoko Ali, **Zhenyu Liao**, and Romain Couillet. Random matrices in service of ML footprint: ternary random features with no performance loss. In: *International Conference on Learning Representations (ICLR)*. 2022. https://openreview.net/forum?id=qwULHx9z1d.

3. **Zhenyu Liao** and Michael W Mahoney. Hessian Eigenspectra of More Realistic Nonlinear Models. In: *Advances in Neural Information Processing Systems (NeurIPS)*. Vol. 34. Curran Associates, Inc., 2021, pp.20104–20117. https://papers.nips.cc/paper/2021/hash/a7d8ae4569120b5bec12e7b6e9648b86-Abstract.html.

4. Michal Derezinski, **Zhenyu Liao**, Edgar Dobriban, and Michael Mahoney. Sparse sketches with small inversion bias. In: *Proceedings of Thirty Fourth Conference on Learning Theory (COLT)*. Vol. 134. PMLR, Aug. 2021, pp.1467–1510. https://proceedings.mlr.press/v134/derezinski21a.html.

5. **Zhenyu Liao**, Romain Couillet, and Michael W. Mahoney. Sparse Quantized Spectral Clustering. In: *International Conference on Learning Representations (ICLR)*. 2021. https://openreview.net/forum?id=pBqLS-7KYAF.

6. Fanghui Liu, **Zhenyu Liao**, and Johan Suykens. Kernel Regression in High Dimension: Refined Analysis beyond Double Descent. In: *Proceedings of The 24th International Conference on Artificial Intelligence and Statistics (AISTATS)*. Vol. 130. PMLR, Apr. 2021, pp.649–657. http://proceedings.mlr.press/v130/liu21b.html.

7. **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. In: *Advances in Neural Information Processing Systems (NeurIPS)*. Vol. 33. Curran Associates, Inc., 2020, pp.13939–13950. https://papers.nips.cc/paper/2020/hash/a03fa30821986dff10fc66647c84c9c3-Abstract.html.

8. Michal Derezinski, Feynman T Liang, **Zhenyu Liao**, and Michael W. Mahoney. Precise expressions for random projections: Low-rank approximation and randomized Newton. In: *Advances in Neural Information Processing Systems (**NeurIPS**)*. Vol. 33. Curran Associates, Inc., 2020, pp.18272–18283. https://papers.nips.cc/paper/2020/hash/d40d35b3063c11244fbf38e9b55074be-Abstract.html.

9. **Zhenyu Liao** and Romain Couillet. On Inner-Product Kernels of High Dimensional Data. In: *2019 IEEE 8th International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (**CAMSAP**)*. IEEE. 2019, pp.579–583. DOI: 10.1109/CAMSAP45676.2019.9022455.

10. Xiaoyi Mai, **Zhenyu Liao**, and Romain Couillet. A Large Scale Analysis of Logistic Regression: Asymptotic Performance and New Insights. In: *IEEE International Conference on Acoustics, Speech and Signal Processing (**ICASSP**)*. IEEE. May 2019, pp.3357–3361. DOI: 10.1109/ICASSP.2019.8683376.

11. Romain Couillet, **Zhenyu Liao**, and Xiaoyi Mai. Classification Asymptotics in the Random Matrix Regime. In: *The 26th European Signal Processing Conference (**EUSIPCO**)*. IEEE. Sept. 2018, pp.1875–1879. DOI: 10.23919/EUSIPCO.2018.8553034.

12. **Zhenyu Liao** and Romain Couillet. The Dynamics of Learning: A Random Matrix Approach. In: *Proceedings of the 35th International Conference on Machine Learning (**ICML**)*. Vol. 80. PMLR, July 2018, pp.3072–3081. http://proceedings.mlr.press/v80/liao18b.html.

13. **Zhenyu Liao** and Romain Couillet. On the Spectrum of Random Features Maps of High Dimensional Data. In: *Proceedings of the 35th International Conference on Machine Learning (**ICML**)*. Vol. 80. PMLR, July 2018, pp.3063–3071. http://proceedings.mlr.press/v80/liao18a.html.

14. **Zhenyu Liao** and Romain Couillet. Random Matrices Meet Machine Learning: A Large Dimensional Analysis of LS-SVM. In: *IEEE International Conference on Acoustics, Speech and Signal Processing (**ICASSP**)*. IEEE. Mar. 2017, pp.2397–2401. DOI: 10.1109/ICASSP.2017.7952586.

Journal papers

1. Yacine Chitour, **Zhenyu Liao**, and Romain Couillet. A geometric approach of gradient descent algorithms in linear neural networks. *Mathematical Control and Related Fields* (2022). DOI: 10.3934/mcrf.2022021.

2. **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. DOI: 10.1088/1742-5468/ac3a77.

3. **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. DOI: 10.1109/TSP.2018.2889954.

4. 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. DOI: 10.1214/17-AAP1328.

Peer reviewing activities

➤ Referee of European Research Council (ERC).
➤ External reviewer of Natural Sciences and Engineering Research Council of Canada (NSERC).
➤ Conferences: NeurIPS, ICML, ICLR, AISTATS, AAAI, ICC Workshop, CAMSAP.
➤ Journals: Journal of Machine Learning Research (JMLR), IEEE Trans. on Pattern Analysis and Machine Intelligence (IEEE-TPAMI), IEEE Trans. on Signal Processing (IEEE-TSP), IEEE Trans. on Neural Networks and Learning Systems (IEEE-TNNLS), Transactions on Machine Learning Research (TMLR), Springer Statistics and Computing (STCO), SIAM Journal on Scientific Computing (SISC), Pattern Recognition (PR), Random Matrices: Theory and Applications (RMTA), Latin American Journal of Probability and Mathematical Statistics (ALEA), Neural Processing Letters (NPL), PLOS ONE.

Research projects

➤ 2023-2025: **PI**, National Natural Science Foundation of China, youth program "*Fundamental Limits of Pruning Deep Neural Network Models via Random Matrix Methods*" (NSFC-62206101), ¥300K.
➤ 2022-2024: **contributor**, National Natural Science Foundation of China, grants for "*Mathematical Foundations for Future Communications (Information Theory)*" (NSFC-12141107), ¥3M. PI: Robert C. Qiu.
➤ 2021-2022: **PI**, CCF-Hikvision Open Fund, *Random Matrix Theory and Information Bottleneck for Neural Network Compression* (20210008), ¥280K.
➤ 2021-2023: **PI**, Fundamental Research Funds for the Central Universities of China, *Large Dimensional Random Matrix Methods in Machine Learning: Theory and Practice* (No. 2021XXJS110), ¥500K.

➤ 2021-2023: **contributor**, Key Research and Development Program of Hubei Provence, *Research on Key Technologies of Next-generation Industrial Internet Network* (2021BAA037), ¥1 000K., PI: Daiming Qu.

➤ 2018-2021: **contributor**, NSF Research Grant, *Combining Stochastics and Numerics for Improved Scalable Matrix Computations* (NSF-1815054), $500K, PI: Michael W. Mahoney.

➤ 2018-2021: **contributor**, Programme d'Investissements d'avenir, *GSTATS IDEX DataScience Chair*, University of Grenoble-Alpes, €300K, PI: Romain Couillet.

➤ 2014-2017, **contributor**, French National Research Agency, *Random Matrix Theory for Large Dimensional Graphs* (ANR-14-CE28-0006), €300K, PI: Romain Couillet.

References

➤ **Prof. Romain Couillet**
  – Full Professor at University Grenoble-Alps, France
  – Holder of the UGA MIAI LargeDATA Chair, University-Grenoble-Alps, France.
  – ✉ romain.couillet@gipsa-lab.grenoble-inp.fr

➤ **Prof. Michael W. 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.
  – ✉ mmahoney@stat.berkeley.edu