

# Zhenyu Liao

## Curriculum Vitae

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📄 Male, Chinese, born in 28/08/1992.

### 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. <https://www.cambridge.org/core/books/random-matrix-methods-for-machine-learning/6B681EB69E58B5F88EDB689C160C682>.

### Papers in conference proceedings

1. 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=qwULHx9zld>.
2. **Zhenyu Liao** and Michael W Mahoney. Hessian Eigenspectra of More Realistic Nonlinear Models. In: *Advances in Neural Information Processing Systems*. Vol. 34. Curran Associates, Inc., 2021, pp.20104–20117. <https://proceedings.neurips.cc/paper/2021/file/a7d8ae4569120b5bec12e7b6e9648b86-Paper.pdf>.
3. Michal Dereziński, **Zhenyu Liao**, Edgar Dobriban, and Michael Mahoney. Sparse sketches with small in-version 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>.
4. **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>.
5. 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>.
6. **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://proceedings.neurips.cc/paper/2020/file/a03fa30821986dff10fc66647c84c9c3-Paper.pdf>.
7. Michal Dereziński, 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://proceedings.neurips.cc/paper/2020/file/d40d35b3063c11244fbf38e9b55074be-Paper.pdf>.

8. **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](https://doi.org/10.1109/CAMSAP45676.2019.9022455).
9. 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](https://doi.org/10.1109/ICASSP.2019.8683376).
10. 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](https://doi.org/10.23919/EUSIPCO.2018.8553034).
11. **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>.
12. **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>.
13. **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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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 \(RMTA\)](#), [Neural Processing Letters \(NPL\)](#), [PLOS ONE](#).

## Research projects

- 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 Province, *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](mailto: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](mailto:mmahoney@stat.berkeley.edu)