

Zhenyu Liao

Curriculum Vitae

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🏠 <https://zhenyu-liao.github.io>
✉ zhenyu_liao@hust.edu.cn
📄 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 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*. (in press) Cambridge University Press, 2021.

Papers in conference proceedings

1. **Zhenyu Liao** and Michael W. Mahoney. Hessian Eigenspectra of More Realistic Nonlinear Models. In: *Advances in Neural Information Processing Systems (NeurIPS)*. 2021.
2. 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, 15–19 Aug 2021, pp.1467–1510.
3. **Zhenyu Liao**, Romain Couillet, and Michael W. Mahoney. Sparse Quantized Spectral Clustering. In: *The Ninth International Conference on Learning Representations (ICLR)*. 2021.
4. 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, 13–15 Apr 2021, pp.649–657.
5. **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.
6. 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.
7. **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.
8. 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.
9. 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.
10. **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.

11. **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.
12. **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.

Journal papers

1. **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.
2. **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.
3. 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.

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**, **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)**, **SIAM Journal on Scientific Computing (SISC)**, **Pattern Recognition (PR)**, **Random Matrices: Theory and Applications (RMTA)**, **Neural Processing Letters (NPL)**, **PLOS ONE**.

Teaching

- 2017 Signal and system 1 lab work with **Prof. Laurent Le Brusquet**, **CentraleSupélec**.
 2021 Deep learning and computer vision with **Prof. Xinggang Wang**, **EIC**, **HUST**.

Research projects

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

Tutorials and invited talks

- Invited talk on “A Random Matrix Approach to Large Dimensional Machine Learning”, **AI+Math Colloquia**, Institute of Natural Sciences, Shanghai Jiao Tong University, 2021.
- Invited talk on “A Random Matrix Approach to Large Dimensional Machine Learning”, **STAT-DS Seminar**, Department of Statistics and Data Science, Southern University of Science and Technology, 2021.
- Invited talk on “A Random Matrix Approach to Large Dimensional Machine Learning”, **Optimization Seminar**, **Academy of Mathematics and Systems Science**, Chinese Academy of Science, 2021.
- Invited talk on “A Data-dependent Theory of Overparameterization: Phase Transition, Double Descent, and Beyond” at **Workshop on the Theory of Over-parameterized Machine Learning (TOPML) 2021**. April 20-21, 2021.
- Invited talk on “Performance-complexity Trade-off in Large Dimensional Spectral Clustering”, **Statistics Seminar**, Research School of Finance, Actuarial Studies and Statistics, Australian National University, Canberra, 2021.
- Invited talk on “Performance-complexity Trade-off in Large Dimensional Spectral Clustering”, **HUAWEI First Mini-workshop on Random Matrix Theory and Machine Learning**, Paris, 2021.

- Invited talk on “Performance-complexity Trade-off in Large Dimensional Spectral Clustering”, *STA 290 Seminar*, Department of Statistics, University of California, Davis, 2021.
- Invited talk on “Dynamical Aspects of Learning Linear Neural Networks”, The Fields Institute for Research in Mathematical Sciences, *Second Symposium on Machine Learning and Dynamical Systems*, 2020.
- Invited talk on “Random Matrix Advances in Large Dimensional Machine Learning”, Shanghai University of Finance and Economics, *Random Matrices and Complex Data Analysis Workshop*, Shanghai, 2019.
- Invited talk on “Random Matrix Viewpoint of Learning with Gradient Descent”, *DIMACS, Workshop on Randomized Numerical Linear Algebra, Statistics, and Optimization*, Rutgers University, 2019.
- Invited talk on “Recent Advances in Random Matrix Theory for Machine Learning and Neural Nets”, workshop of the *Matrix* series on “*Random matrix theory faces information era*”, Kraków, Poland, 2019.
- Invited talk on “Dynamical Aspects of Deep Learning” (with Y. Chitour), *Séminaire d’Automatique du plateau de Saclay of iCODE institute*, Paris, France, 2019.
- Invited talk on “Recent Advances in Random Matrix for Neural Networks”, *Workshop on deep learning theory*, Shanghai JiaoTong University, China, 2018.
- **Tutorial** on “Random Matrix Advances in Machine Learning and Neural Nets” (with R. Couillet and X. Mai), *The 26th European Signal Processing Conference (EUSIPCO’18)*, Roma, Italy, 2018.

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 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