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 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 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, 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 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.
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** and Romain Couillet. A Large Dimensional Analysis of Least Squares Support Vector Machines. *IEEE Transactions on Signal Processing* **67**(4) (Feb. 2019), 1065–1074.
2. 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*, ¥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