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Education

2018-today (Palaiseau, France) — Université Paris-Saclay. **Ph.D.** candidate in *hardware oriented AI.*

2017-2018 (Paris, France) — École Normale Supérieure. **M.Sc.** in Statistical and Quantum Physics.

2014-2017 (Paris, France) — École Polytechnique. **M.Sc.** in Physics, **B.Sc.** in Applied Mathematics, Quantum Physics and Computer Science. Joined through a nationwide competitive exam, *ranked 31 out of 770 applicants.*

2012-2014 (Orsay, France) — Lycée Blaise Pascal. Classe préparatoire MP*. Intensive undergraduate program in Mathematics, Physics and Computer Science.

Research Experience

2018-today (Orsay, France) — Université Paris-Saclay.
Ph.D. supervised by Damien Querlioz and Liza Herrera-Diez.

- Relevant topics : continual learning, biologically plausible deep learning, optimization, hardware design.
- Collaborators for AI : Benjamin Scellier (Google Zurich), Yoshua Bengio (Mila).
- Collaborators for hardware : Julie Grollier (UM-Φ CNRS, Thales), Jean-Michel Portal (Aix-Marseille Université), Elisa Vianello (CEA Leti).
- Contributions : 6 first author contributions (**3 journal publications**, 3 conference acceptances) in machine learning, physics and neuroscience, **1 paper award**.
- Description : I have been working on equilibrium propagation, a learning algorithm promising for on-chip learning. I showed that it could scale to deeper networks trained on natural scenes by estimating the loss gradient more accurately. I also developed a way to reduce 'catastrophic forgetting' in binarized neural networks without computational overhead by discovering links between synaptic models from computational neuroscience and binary optimization. On the hardware side, I upgraded a synapse design using emerging resistive memory technology from binary to ternary quantization, consistently increasing the model accuracy without overhead.

2018, 4 months (Orsay, France) — Centre for Nanoscience and Nanotechnology. **Research assistant** in device physics in the Integnano team. Carried numerical simulations to study magnetic properties for the the design of a complex artificial synapse. Led to **one conference acceptance** (presenting author).

2017, 4 months (Paris, France) — École Normale Supérieure (Statistical Physics Lab). **Research assistant** in Lydéric Bocquet team. Solved the problem of measuring friction forces on wet surfaces by designing a tribometer with a macroscopic tuning fork. Led to **one journal paper** (second author).

Teaching Experience

Orsay, France (2018-today) — Université Paris-Saclay. Taught children from 6 to 14 years old complex scientific concepts through practical tutorials on hydrodynamics, energy production and computer science.

Orsay, France (2015-2016) — Lycée Blaise Pascal. Trained undergraduate students in Mathematics, as an oral examiner, for the challenging entrance exams to top French engineering schools (two hours each week).

Computer skills

Deep learning — Python (PyTorch), standard libraries for data analysis (e.g. Pandas).
Software project — PHP, JavaScript (jQuery), MySQL.
Workflow — Git (code versioning), Vim (code editing), LaTeX (academic writing).

Journal Papers

1 **Laborieux, A.**, Ernoult, M. Hirtzlin, T. & Querlioz, D. (2021) Synaptic Metaplasticity in Binarized Neural Networks, Nature Communications, accepted

2 **Laborieux, A**, Ernoult, M., Scellier, B., Bengio, Y., Grollier, J., & Querlioz, D. (2021). Scaling equilibrium propagation to deep convnets by drastically reducing its gradient estimator bias. Frontiers in neuroscience, 15, 129.

3 **Laborieux, A.**, Bocquet, M., Hirtzlin, T., Klein, J. O., Nowak, E., Vianello, E., Portal, J-M & Querlioz, D. (2020). Implementation of Ternary Weights With Resistive RAM Using a Single Sense Operation per Synapse. IEEE Transactions on Circuits and Systems I : Regular Papers.

4 Diez, L. H., Liu, Y. T., ..., **Laborieux, A.**, ... & Ravelosona, D. (2019). Nonvolatile ionic modification of the Dzyaloshinskii-Moriya interaction. Physical Review Applied, 12(3), 034005.

5 Canale, L., **Laborieux, A.**, Mogane, A. A., Jubin, L., Comtet, J., Lainé, A., ... & Niguès, A. (2018). MicroMegascope. Nanotechnology, 29(35), 355501.

Conferences

1 **Laborieux, A.**, Ernoult, M. Hirtzlin, T. & Querlioz, D. Synaptic Metaplasticity in Binarized Neural Networks, Computational and Systems Neuroscience (Cosyne) 2021

2 **Laborieux, A**, Ernoult, M., Scellier, B., Bengio, Y., Grollier, J., & Querlioz, D. Scaling equilibrium propagation to deep convnets by drastically reducing its gradient estimator bias. NeurIPS 2020 Workshop, 'Beyond BackPropagation : Novel Ideas for Training Neural Architectures)

3 **Laborieux, A.**, Bocquet, M., Hirtzlin, T., Klein, J. O., Diez, L. H., Nowak, E., ... & Querlioz, D. (2020, March). Low power in-memory implementation of ternary neural networks with resistive RAM-based synapse. In Proceedings of the 2020 2nd IEEE International Conference on Artificial Intelligence Circuits and Systems (AICAS) (pp. 136-140). **2nd Best Paper Award**

4 Herrera-Diez, L., Liu, Y., ... **Laborieux, A.**, ... & Ocker, B. (2020, August). Electric field control of magnetism. In Proceedings of Spintronics XIII (Vol. 11470, p. 114703G). International Society for Optics and Photonics. (Presenting author)

5 **Laborieux, A.**, Hirtzlin, T., Herrera-Diez, L., & Querlioz, D. Memory Effects in Binarized Neural Networks, *X-Data Science Summer School 2019*

Additional Experiences & Skills

Military French Military Police Force (Coulommiers, France, from Sep 2014 to Feb 2015).

Language French (native), English (full professional), Chinese (full professional, HSK 5 in 2017).