Axel Laborieux

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PROFESSIONAL EXPERIENCE

Friedrich Miescher Institute (affiliated to Novartis) **Basel, Switzerland**
Postdoctoral researcher in Neuro-AI. *Oct 2021–Present*

- Designed an innovative AI algorithm modelling how the brain can learn locally through neuronal oscillations. Demonstrated effectiveness on large-scale image recognition surpassing prior theories by 88%, and leading to contributions at NeurIPS 2022 (oral) and ICLR 2024.
- Gained understanding of how self-supervised deep learning avoids the collapse of learned representations. Designed a new model which translated into improved robustness on large-scale vision settings, accepted at NeurIPS 2023.

SKILLS

Computer: Python (6 years), Linux, Shell, Git, Slurm. **Libraries:** PyTorch (3 years), JAX, Flax, Haiku (3 years).

Deep learning: Supervised, self-supervised, and continual learning, multi-GPU training. Experience with standard architectures (ResNet, Transformer) and datasets (ImageNet, WikiText). Experience with TPUs on Google Cloud.

EDUCATION

Paris-Saclay University **Palaiseau, France**
Ph.D. in Physics. *Sep 2018–Sep 2021*

Title: "Bio-inspired continual learning and credit assignment for neuromorphic computing"
Main topic: **software-hardware co-design for Edge AI**.

- Created a **continual learning** algorithm dedicated to binarized neural network accelerators for continuously learning from incoming data while matching deep learning baselines.
- Improved by 7× the performance of an **on-chip local learning** algorithm dedicated to analog neural networks on natural images by designing a better gradient estimator.
- Upgraded a physical memory device based on resistive RAM technology from binary to ternary **quantization**, increasing model performance without circuit overhead.

Output: **6 first-author contributions** (3 journal publications, 3 conference acceptances) spanning machine learning, physics and neuroscience.

Ecole Normale Supérieure **Paris, France**
M.Sc. in Statistical and Quantum Physics. *Sep 2017–Sep 2018*

Ecole polytechnique (France's top engineering school) **Palaiseau, France**
B.Sc. and M.Sc. in applied Mathematics and Computer Science. *Sep 2014–Sep 2017*

SELECTED PUBLICATIONS

- **Laborieux, A.**, & Zenke, F. (2024). Improving equilibrium propagation without weight symmetry through Jacobian homeostasis. *ICLR* (accepted, main conference)
- Halvagal, M. S.*, **Laborieux, A.***, & Zenke, F. (2023). Implicit variance regularization in non-contrastive SSL. *NeurIPS* (* equal contribution)
- **Laborieux, A.**, & Zenke, F. (2022). Holomorphic equilibrium propagation computes exact gradients through finite size oscillations. *NeurIPS*, *35*, 12950-12963. **Oral (top 7%)**
- **Laborieux, A.**, Ernoult, M., Hirtzlin, T., & Querlioz, D. (2021). Synaptic metaplasticity in binarized neural networks. *Nature communications*, *12*(1), 2549. **(Covered in press by Tech Xplore)**

AWARDS

- Swiss National Science Foundation postdoctoral fellowship. Leading a two-years research project aimed at modelling cortical computation (CHF190k+, **top 9%** applications).
- **Best thesis award** for 2021 from the Engineering Sciences Graduate School of Paris-Saclay (€2k).
- **NeurIPS 2022 scholar award**, was granted hotel and travel tickets for attending NeurIPS.
- Google TPU Research Cloud fellow.

INVITED TALKS AND SEMINARS

- Kenyon Lab, **Los Alamos National Laboratory**, "*Computing local gradients with Holomorphic EqProp*".
- Contributed talk at the workshop "*Recent advances in understanding artificial and biological neural networks*" at **Les Houches school of physics**, France.
- **CEA Grenoble**, Vianello Lab. "*Credit assignment through neural oscillations*".
- Forschungszentrum Jülich, Neftci Lab. "*Credit assignment through neural oscillations*".
- Machine Learning seminar at **IBM Zürich**.
- Cognitive Machine Learning (CoML) team led by Prof. Dupoux at **Ecole Normale Supérieure Paris**.

ADDITIONAL EXPERIENCE AND SKILLS

Reviewer: NeurIPS, ICLR, ICML, Frontiers, IEEE TCAS, ISCAS.

Languages: French (native), English (fluent), Mandarin (fluent).

Leadership: Served in the French police force for a 4-month military service program.

Hobbies: Sinology, Calligraphy, Motorcycle.