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Ecole Polytechnique
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Reading and writing neural codes with single-cell resolution, single-spike precision and inter-areal access

The generation of complex neural functions such as perception, cognition, and action relies on neural codes distributed across multiple brain areas, with individual neurons and single spikes serving as the fundamental units of these codes. Multiphoton holographic optogenetics holds great promise for probing neural codes with high spatiotemporal precision in all-optical read/write experimental paradigms. Yet, current all-optical read/write technology is on one hand limited to small fields of view (<1–2 mm²), and on the other hand provides mostly binary on/off neuronal modulation. I will present two complementary developments pushing the speed, throughput and scale of all-optical read/write technologies and opening previously inaccessible classes of experiments: the ability to interrogate with single-cell resolution cortico-cortical pathways and the ability to precisely interface with spike train dynamics.

References

- *Probing inter-areal computations with a cellular resolution two-photon holographic mesoscope*. Abdaldim et al, BioRxiv (2023). https://doi.org/10.1101/2023.03.02.530875
- *Probing neural codes with two-photon holographic optogenetics*. Adesnik & Abdeladim, Nat Neurosci (2021). https://doi.org/10.1038/s41593-021-00902-9