BCL5

5th Workshop on Brain, Computation, and Learning

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July 03, 2025 | 9:00 am – 10:30 am
Faculty Hall

Towards a Polymer-Based 3D Neural Interface: Integration with Behavioral Decoding in a Rodent Stroke Model

Abstract: The design of neural interfaces for brain-machine applications increasingly demands materials that combine biocompatibility with high-resolution signal capture. To this end we are developing a polymer-based neural sensor designed for 3D brain-conforming surfaces, particularly suited for cortical curvature in small-animal models. The 3D microprinted base structure with conical pillars has been successfully fabricated and coated with Titanium and Aluminum nitride. The current phase focuses on femtosecond laser scribing to define electrode geometries, which presents technical bottlenecks due to Z-axis drift on curved substrates. A bio-inspired beam-shaping strategy is being explored to address this. Parallelly, a behavioral decoding pipeline has been established using a single-pellet retrieval task in a rodent stroke model. Kinematic features are extracted via DeepLabCut, offering detailed limb tracking for motor state classification. Once the sensor is operational, neural signals from network-level and focal recordings will be integrated with this behavioral model to evaluate decoding performance. This modular strategy combining adaptive materials, topographical fabrication, and behavioral-state decoding lays the groundwork for future closed-loop neuromodulation systems.