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Building and maintaining the architecture of the locomotor system: from genes to function.

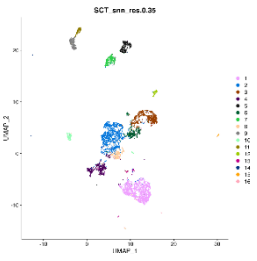
Life is constantly in motion, as the Renaissance philosopher Michel De Montaigne once said. One common behavior animals use to find food, mates, or evade predators is locomotion. In animal appendages, the morphology of muscles is key in ensuring precise movement. These muscles are innervated by a unique wiring of motoneuron axon terminals that control the timing and intensity of muscle contraction. However, how muscles and motoneurons coordinate their development to establish these unique axon-muscle connections and maintain them throughout adult life remains largely unknown.
At our lab, we aim to define the genetic program controlling the development and maintenance of muscle morphologies and the axon-muscle connectome architecture in Drosophila legs at the single-cell level. To achieve our goals, we employ single-cell RNA profiling and a novel 3D spatial transcriptomic approach combined with genetic techniques to visualize and selectively modify the genotype of individual cells in a developing or adult organism. We use state-of-the-art microscopy (confocal and STED) and a unique behavioral technology (the Flywalker) to analyze the impact of these genetic manipulations on cell architecture and locomotion.

With these technologies, our research addresses three key questions:
Q1: Muscle Morphology Development - Is there a muscle-specific program controlling the development of muscle morphology in parallel to the general program of myogenesis?

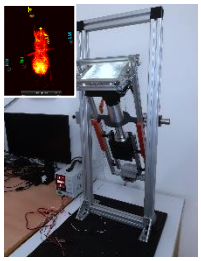
Q2: Muscle Innervation Development - What are the molecular and cellular mechanisms controlling the building of the axon-muscle connectome?

Q3: Muscle Innervation Maintenance - Is there a genetic program in adult MNs and muscles actively maintaining the architecture of the muscle innervation once it is established?

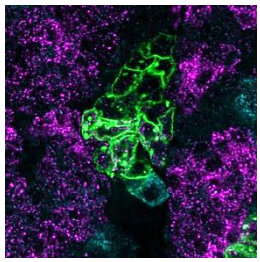
If you find any of these questions or technologies interesting, please do not hesitate to contact us!



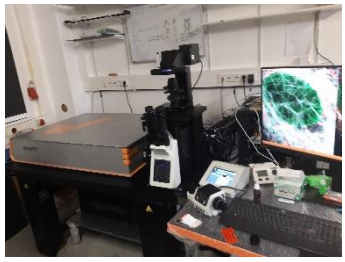
Single cell Seq



Flywalker



smFISH/spatial transcriptomic



STED microscopy