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Integrating imaging and quantitative analysis to study neuronal morphology and synaptic organization

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The development and function of neuronal circuits depend on the precise organization of neuronal morphology and synaptic architecture. These processes are shaped by intercellular communication mechanisms, including astrocyte-derived signals influencing neuronal growth, branching and synapse formation[1]. Although advanced microscopy provides detailed structural information, extracting robust and reproducible quantitative descriptors of neuronal organization remains challenging[2]. This talk presents an integrated imaging and analysis framework to investigate how defined extracellular cues modulate neurite complexity and synaptic organization in primary neuronal cultures. This approach highlights the value of combining confocal imaging with machine learning-guided quantitative analysis to generate reproducible morphological and synaptic readouts that can be integrated with molecular datasets to link structural phenotypes to underlying cellular programs and intercellular communication.

[1] Allen NJ, Eroglu C. (2017). Cell Biology of Astrocyte-Synapse Interactions. Neuron, 96(3), 697-708. doi: 10.1016/j.neuron.2017.09.056
[2] Bagheri N, Carpenter AE, Lundberg E, Plant AL, Horwitz R. (2022). The new era of quantitative cell imaging-challenges and opportunities. Molecular Cell, 82(2), 241-247. doi: 10.1016/j.molcel.2021.12.024

Giulia Favetta is a postdoctoral researcher at the Department of Biology, University of Padova (Italy). She obtained her PhD in Biosciences (Cell Biology and Physiology) in 2025, investigating D1 receptor signaling in striatal astrocytes and how astrocyte-derived cues shape neuronal maturation and synaptic organization. Her work integrates primary neuron/astrocyte cultures and astrocyte-conditioned media (ACM) paradigms with quantitative confocal microscopy, proteomics and transcriptomics, supported by robust image-analysis pipelines for reproducible quantification across batches and large datasets, linking cellular phenotypes to underlying molecular programs. She received the University of Padova Graduate Alumni Award (2022), has co-supervised BSc/MSc students, and served as a teaching assistant in BSc and MSc courses. She authored a Progress in Neurobiology review (2025) and co-authored several peer-reviewed publications in international journals.

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