NJIT New Jersey Institute of Technology

BME

Department of Biomedical Engineering
Graduate Seminar

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University of Michigan

Subject: Exploring learning in C. elegans through engineered behavioral arenas, Genetics, and mathematical models

Abstract:

The mechanisms of memory and learning are central topics in contemporary neurobiology. Although mammalian models are widely used to elucidate the function of brain and big neuronal networks, alternative systems are needed to decipher the contribution of individual neurons, neuronal circuit's dynamics, and target genes. C. elegans nematode is one of the most broadly used model organisms in neurobiology and the biology of aging. It is also the only organism of which the entire nervous system is fully mapped. Despite its only 305 neurons, C. elegans demonstrates remarkable associative and non-associative learning, studied mainly in the context of chemical cues. Recently, we showed for the first time that C. elegans nematodes are capable of spatial learning in a maze environment. We employ 3D-printing technology to build a novel and versatile behavioral arena, a custom-made Worm-Maze platform. We establish that C. elegans young adults locate food in T-shaped mazes an, based on this experience, can learn which maze arm to reach. Learning is sufficient to reverse nematodes' inherent preferences, depends on mechanosensation and proprioception, and declines with aging. In parallel with the experimental thrust, we are developing a mathematical model to capture the dynamics of neuronal circuits that steer maze learning. The model generates new research hypotheses and suggests the presence of an interneuron responsible for sensory integration. In addition, we are customizing a commercially available 3D printer, to use a nematode-friendly hydrogel as ink. This way we aspire to build the first 3-dimensional behavioral arenas for nematodes, to explore their learning and navigation abilities in a 3D environment.

Bio:

Dr. Eleni Gourgou received her BS in Biology from the National & Kapodistrian University of Athens (NKUA), Greece, and earned her PhD in Animal Cell Physiology in 2010, also from NKUA. She joined the University of Michigan in 2011 as a postdoctoral fellow, and she worked with microfluidic biochips and bio-MEMS. Later, she shifted her focus on the dynamics of biological systems, and in 2015 she began working on learning and aging, and on developing new behavioral assays for small invertebrate animals. She is currently a Research Faculty at the University of Michigan, in the rank of Assistant Research Scientist, splitting her time between Mechanical Engineering Dept and the Institute of Gerontology, Medical School.

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