C. elegans neurobiology, behavior and neuronal dynamics

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As a new research faculty working at the interface between biology and engineering, I use *C. elegans* to address neurobiology related questions by employing technology and engineering tools. In this talk, indicative results of selected research efforts will be presented.

Our first research thrust focuses on the dynamics of biological systems. We explore experimentally the stimulus-triggered Ca^{2+} transients in *C. elegans* ASH sensory neuron and we build a mathematical and computational model which captures their intriguing dynamics. The model is built based on biophysical events and molecular cascades known to unfold as part of neurons' Ca^{2+} homeostasis mechanism, and on signaling events. The model captures the stimulus-evoked Ca^{2+} transients in the *C. elegans* ASH sensory neuron, and it can be used to predict ASH response to complex stimulation pulses. The proposed model includes for the first time the ASH Ca^{2+} dynamics observed during both "on" and "off" responses. This effort is the first to propose a dynamic model of the Ca^{2+} transients' mechanism in *C. elegans* neurons, based on biochemical pathways of the cell's Ca^{2+} homeostasis machinery.

The second thrust involves establishing *C. elegans* learning ability and decision making in the structured environment of a T-shaped maze. Using 3D printing technology, we create mazes and we test worms biased/unbiased decision making and learning, triggered by the presence of food at one maze end. We find that *C. elegans* are capable of learning where to turn in a maze, and that their experience is sufficient for them to overcome their aversion of specific structural cues. We are currently working on untangling the mechanism that steers this behavior.

Work is conducted in collaboration with faculty and students at the UoM Mechanical Engineering Dept and the Medical School.