SORBONNE UNIVERSITÉ

Interfaces pour le vivant

Title of the research project: **Integrative modeling of a "swimming neuron"**

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Subject description:

Paramecium is a large unicellular eukaryote organism which swims in fresh water using its cilia. When it hits an obstacle, mechanosensitive channels open, depolarize the membrane and trigger an action potential. In turn, the action potential triggers a reversal of the swimming direction, followed by a change of direction. Paramecium displays some of the basic physiological features found in nervous systems of multicellular organisms, and for this reason it has been called "a swimming neuron". This project combines behavioral experiments and theoretical modeling to develop an integrated model of spatial navigation in this elementary sensorimotor system, including models of the action potential, transduction currents, and electromotor coupling. Detailed behavioral modeling will be performed by using and further developing a 3D tracking system, both in free environment and in microengineered environments with obstacles. Multisensory integration will be addressed by studying how Paramecium finds a chemical source when it is placed behind a U-shaped obstacle. Electrophysiological modeling will be performed by measuring ionic currents with microelectrodes in an immobilized Paramecium, together with water fluxes produced by the cilia using particle image velocimetry. Mechanotransduction will be measured by mechanical stimulation with a probe mounted on a piezoelectric transducer. Overall, this work will allow building a closed-loop model of an elementary spiking sensorimotor system, linking physiology and ecologically relevant behavior.