Towards the Whole Brain Simulation of the Insect Olfactory System

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The insect brain is a sufficiently complex system to display a primitive form of intelligence. Insects are capable of many sophisticated behaviours, such as learning and multimodal information processing. We want to promote the understanding of information processing in brains through computer simulations of the insect brain. Our current model system is the odour-source localisation behaviour of silkmoth males, controlled by a brain area called LAL-VPC. We have implemented a first model of the LAL-VPC that allows parallelized simulation of 72 representative active multi-compartment model neurons on a cluster machine (RICC, Riken). A parameter estimation method is being developed to reconstruct silkmoth neural circuits in silico from single neurons to the circuit level. Tightly related developments are a software tool for the rapid automatic or user-assisted extraction of neuron morphology and the creation of a standard brain that will provide the common framework to integrate multiscale data. These methods and a large amount of accumulated database materials will allow very realistic 4D simulations of brain processes from sensory input to behavioural output and lead to a deeper understanding of the organization of brain systems.