SLIME MOLD – ORGANIC MEMRISTOR HYBRID SYSTEMS TOWARDS UNCONVENTIONAL INFORMATION PROCESSING

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Slime mould Physarum polycephalum is a single cell visible by an unaided eye. The slime mould optimizes its network of protoplasmic tubes to minimize expose to repellents and maximize expose to attractants and to make efficient transportation of nutrients. These properties of P. polycephalum make it a priceless substrate for designing novel sensing, computing and actuating architectures in living amorphous biological substrate. The present work was done within the initial stage of PhyChip project. The results are mainly connected to the loading of the slime mold with magnetic nanoparticles and with variation of electrical properties of organic memristive devices when the slime mold is grown on them.

We have demonstrated that, by loading Physarum with magnetic particles and positioning it in a magnetic field, we can impose analog control procedures to precisely route active growing zones of slime mould and shape topology of its protoplasmic networks.

Working principle of the organic memristive devices are based on the significant difference of the conductivity of polyaniline (PANI – active material of the device) when it is in oxidized and reduced states. It was shown that the propagation of Physarum on the PANI layer in the insulating non doped state results in the significant increase of the conductivity of zones, that were in a contact with slime mold. Successive doping of the system inverts the situation: zones, free from Physarum, become more conductive, while those covered with the slime mold become more insulating. Such behavior can establish a basis of electrical readout of the network, realized during the growth. Moreover, according to the task, the network can form “wires” (more conducting areas) or “insulators” (less conducting areas) in zones of the contact of Physarum and PANI.