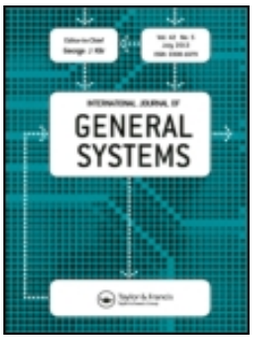

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GUEST EDITORIAL

Slime mould computing

Slime mould, *Physarum polycephalum*, is a large single cell with intriguingly smart behaviour. The slime mould shows outstanding abilities to adapt its protoplasmic network to varying environmental conditions. The slime mould can solve tasks of computational geometry, image processing, logics and arithmetics when data are represented by configurations of attractants and repellents. In this special issue, we present groundbreaking results on implementation of computing devices with living and simulated slime mould. The showcases include obstacle-free path planning, implementation of cellular automata, laboratory realization of logical gates, formalization of the slime mould's behaviour, constructions of the slime mould programming language, production of hybrid computing elements, designing evacuation procedures and formalization of uncertainties of the slime mould's behaviour.

Path planning is amongst the biblical problems of computer science. Using a particle-based model of the slime mould, Jeff Jones – "A Morphological Adaptation Approach to Path Planning Inspired by Slime Mould" – shows how a collision-free path can be approximated via morphological adaptations of the slime mould. Slime mould computes the path while guided by gradient of attractants towards the destination and avoids obstacles because they emit repellents.

Tomohiro Shirakawa and his colleagues grow the slime mould on a regular two-dimensional array of agar blobs. The surfaces are occupied by the slime mould and the connections between neighbouring blobs are made of the protoplasmic tubes. The whole architecture reminds a locally connecting parallel processor. Some cellular-automata-models proposed in their paper "Construction of Living Cellular Automata using the *Physarum* Plasmodium" enlighten us on how the slime mould propagates and interacts with its environment.

Richard Mayne and Andrew Adamatzky employ plasmodial phototactic responses to construct laboratory prototypes of NOT and NAND logical gates with electrical inputs/outputs and optical coupling. Their paper "Slime Mould Foraging Behaviour as Optically Coupled Logical Operations" shows that the slime mould gate constructed is reusable and fault tolerant.

Krzysztof Pancerz and Andrew Schumann – "Rough Set Models of *Physarum* Machines" – formalize behaviour of the slime mould using transition systems over rough sets. They develop a formal language of the slime and apply their findings to discover predecessor anticipators in the slime mould's state transitions.

Qing Wang and co-authors develop a unique algorithm of shortest path computation inspired by foraging behaviour of the slime mould. In their paper "An Anticipation Mechanism for the Shortest Path Problem Based on *Physarum polycephalum*" they present an iterative modification of the famous "amoeba algorithm", their version incorporates some anticipatory mechanisms.

Tatiana Berzina and colleagues – "Hybrid Slime Mould-containing System for Unconventional Computing" – overview their results on internalization of functional nanoparticles in the slime mould and control of the particle transportation inside the slime mould using attractants and repellents. By growing the slime mould on conductive polymers, they modify properties of the polymers and thus pave a way towards novel bio-electronic devices.

Optimal planning of people evacuation from buildings is one of the actual problems of crowd dynamics and social physics. In their paper "Cellular Automaton Model of Crowd Evacuation Inspired by Slime Mould", Kalogeiton and co-authors propose an efficient cellular automaton model inspired by foraging behaviour of the slime mould. They demonstrate efficiency and robustness of their model in several real-life scenarios.

When propagating towards a source of attractants while avoiding obstacles, the slime mould rarely chooses exactly the same route twice. In laboratory experiments, we always find subtle or sometimes even substantial variations in the slime mould's behaviour from one trial to another. Formalization of this uncertainty in the slime mould's behaviour is presented in the paper "The Double-Slit Experiment with *Physarum polycephalum* and *p*-Adic Valued Probabilities and Fuzziness" by Andrew Schumann and Andrew Adamatzky. The authors construct *p*-adic valued fuzzy logic to describe self-inconsistencies in the slime mould's individual acts.

Slime mould is always in a flux. Protoplasmic tubes change their shape and location, they branch or retract. To make slime mould computers function longer we can hybridise them with chemical substances. The paper "Conducting Polymer-coated *Physarum polycephalum* Towards the Synthesis of Bio-hybrid Electronic Devices" by Ben de Lacy Costello and co-authors shows how such a hybridization can be implemented. The functionalised coating of the slime mould is done with the conductive organic polymer polypyrrole. During the hybridization, only selected protoplasmic tubes change, while the rest of the protoplasmic network remains intact: living slime mould coexists with its highly conductive coated parts.

This special issue will allow computer scientists, mathematicians, physicists, chemists, biologists and engineers to look at the meaning of computation from an unusual perspective and it will inspire them to design their own theories of computation and prototypes of living computing devices.

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