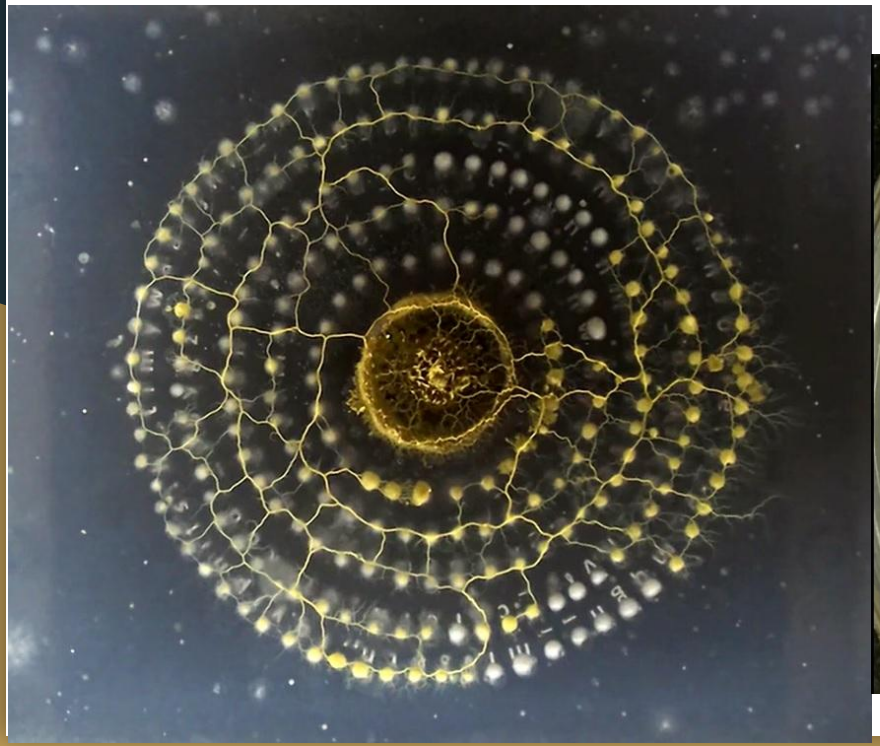
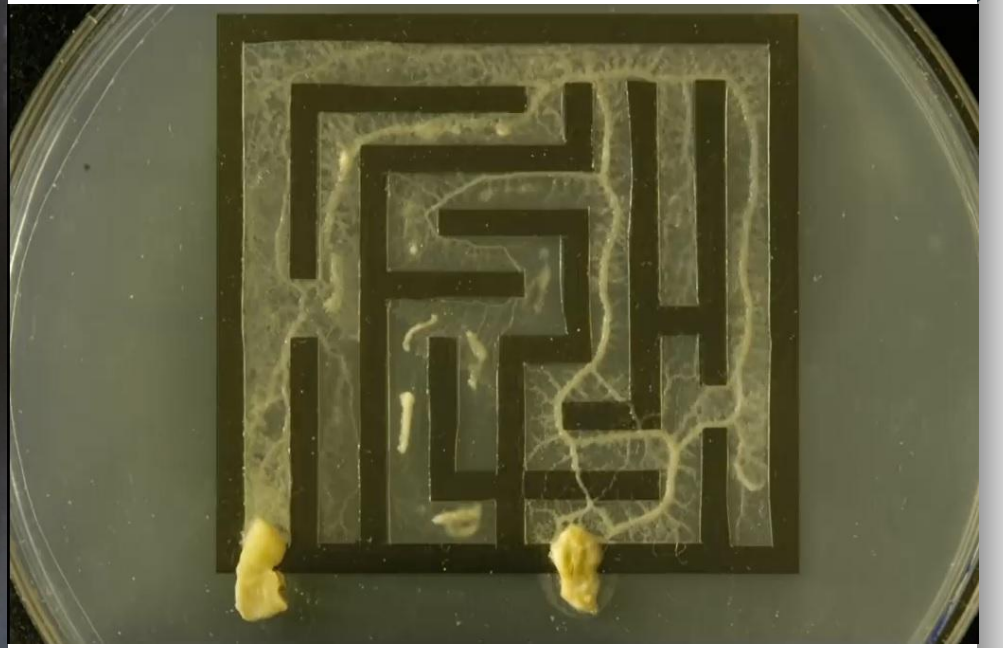
Building logical gates with Slime Mold

Slime Mold in Nature

Slime Mold in the Lab





Discovering Boolean Gates in Slime Mould

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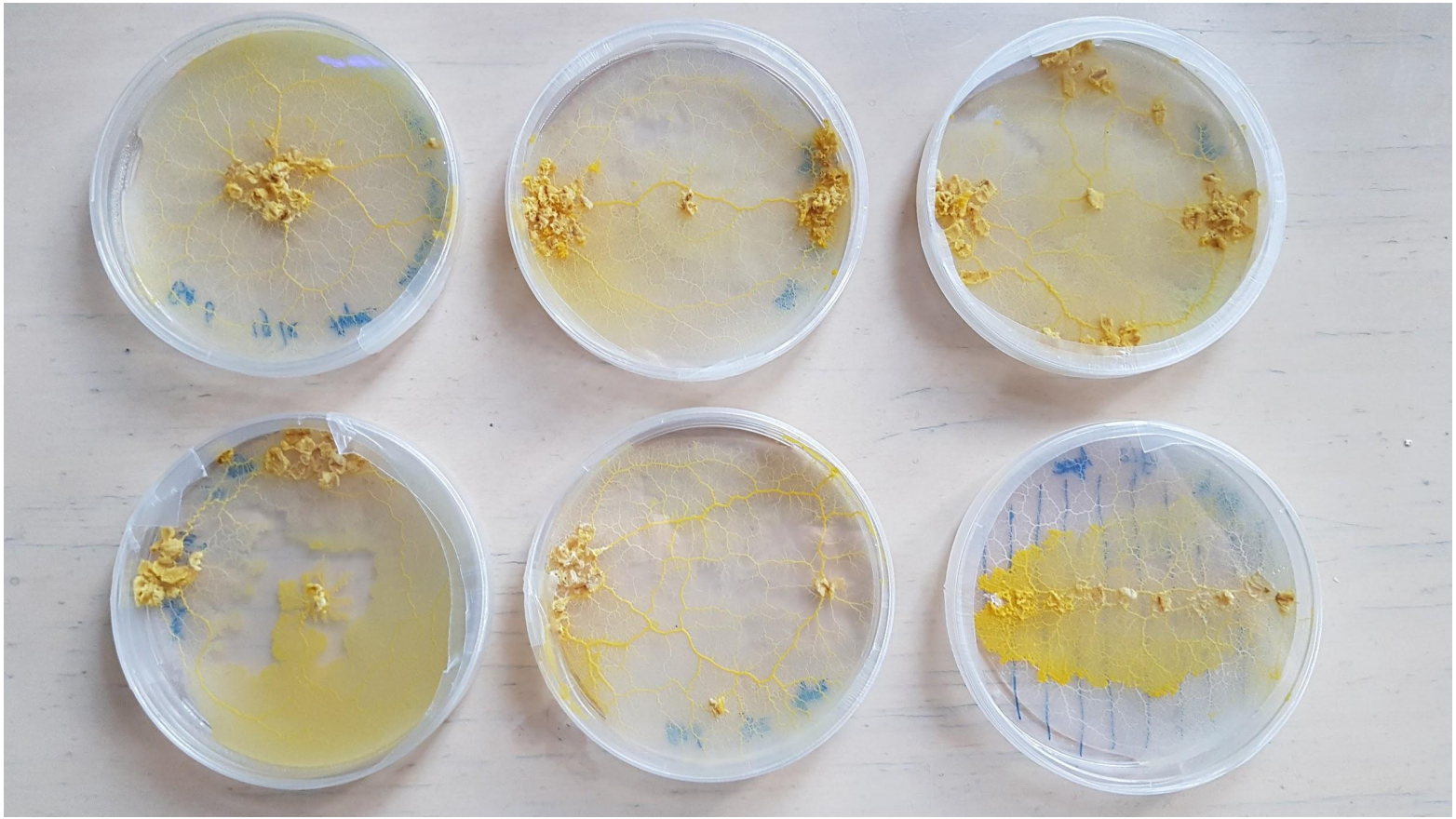
Abstract

Slime mould of Physarum polycephalum is a large cell exhibiting rich spatial non-linear electrical characteristics. We exploit the electrical properties of the slime mould to implement logic gates using a flexible hardware platform designed for investigating the electrical properties of a substrate (*Mecobo*). We apply arbitrary electrical signals to 'configure' the slime mould, i.e. change shape of its body and, measure the slime mould's electrical response. We show that it is possible to find configurations that allow the Physarum to act as any 2-input Boolean gate. The occurrence frequency of the gates discovered in the slime was analysed and compared to complexity hierarchies of logical gates obtained in other unconventional materials. The search for gates was performed by both sweeping across configurations in the real material as well as training a neural network-based model and searching the gates therein using gradient descent.

Keywords: Slime Mould, Physarum, Unconventional computing

Grow Test



Confinement