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Extended Abstract

Robotics and Artificial Intelligence: Cell Assemblies and Robots - Christian Huyck - Middlesex University, UK

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Abstract

Cell Assemblies (CAs) are crucial to human and mammalian cognition and behaviour. A CA is a group of neurons that can maintain firing without external stimulation. Our symbolic concepts, like dog, are represented by CAs. Many non-human mammals do not have symbols, but they do have concepts. So, a rat will probably have a generic CA for cat, which will fire when a cat is present.

There is an enormous gap in the academic community's understanding of CAs, how they affect motor control, and how they regulate sensing. Theoretically, my CA for walk to the door is firing when I am walking to the door, but it is not clear how that interacts with central pattern generators (CPGs), or even if those neurons that execute the CPG are part of the CA. Similarly, it is clear that, for instance, neurons in the primary visual cortex are involved when a human view a dog, but it is not entirely clear how they lead to the ignition of the dog CA, or which neurons are in the dog CA.

As there's a gap, I, and my collaborators, are trying to fill the gap. I am a computer scientist, so I am trying to develop programs based on CAs. In particular, we think embodiment is important, and that working from simulated neurons is important. So, we work with robots, virtual and physical. We work with spiking neurons, typically point models. We have been developing neural topologies that can be used for virtual agents. We are now working as part of the Human Brain Project, developing topologies that can be reused by others to implement agents. We have done a fair bit of work on developing "higher" function such as neuro-cognitive models of natural language parsing and learning a two-choice task.

We have also done some work with physical robots. We developed the neural software for a simple Braitenberg robot that followed lines using vision; this was based on our CA work. We are currently developing CA based neural models for grasping control that are also neuro-cognitive models of a stop task. More recently, we have been working on the forward model for a fast walking robot. This work does not use currently make use of CAs. Instead, it approximates standard analytical models (like a cart and pole) with point neurons; neurons are turing complete. The plan is to continue on with this work. We can explore the use of CAs in virtual robots. It is my contention that following this approach, mimicking the human model as closely as possible, physically, neurally, and psychologically is the best way to get to Turing test passing AI. It also has the benefits of furthering our understanding of human neural and psychological processing and developing systems that are useful. These more useful systems include robots.

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