Review of: "Self-Replication, Spontaneous Mutations, and Exponential Genetic Drift in Neural Cellular Automata"

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Potential competing interests: No potential competing interests to declare.

Here is a critical analysis of some potential limitations and areas for improvement in this paper - this was reviewed by myself and one of my team members.

The paper effectively shows that a Neural Cellular Automata(NCA) is capable of self-replication.

Unlike the original NCA paper where the rules of the CA as the genome of the organism, this paper interprets the rules as the “physics” of the CA and takes biological phenomena as emergent. This is justified by the fact that NCA may produce rules that generate open-endedness, however this is in the opinion of the reviewer is a conceptual mistake.

Instead of taking the rules as the genome, the paper takes an analog seed that grows to a full pattern plus another seed, this is concluded as the organism is capable of growth and replication. However under the interpretation of the original NCA, this couples the behaviour of growth and replication, something that is not observed in biology.

Under the article interpretation, the sign of genetic drift in the growth + replication experiment may be a precursor to open-ended novelty. However there is no strong evidence in the article to conclude this.

Of particular interest is the seed cloud experiment, where it is shown an interest phenomena that may develop to different patterns depending on the spatial configuration of the seeds. This is both interesting in the original and this article interpretation of the rules.

The article effectively concludes that under this rule interpretation the system is not undergoing open-ended evolution and that NCA are designed for convergent processes. This suggest that NCA are models specifically targeted for the problem of morphogenesis, and they are not meant to be models for open-ended exploration environments.