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# Robots Reverse-engineer Worm Regeneration Model

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by Elizabeth Doughman, Editor-in-Chief

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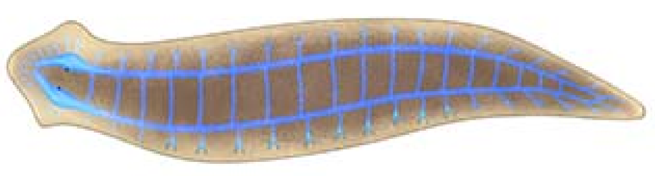

Artificial intelligence (AI) has reverse-engineered the regeneration mechanisms of small worms in the genus planaria, according to a new study from Tufts University published in *PLOS Computational Biology*. This is the first comprehensive model of planaria regeneration and demonstrates one of the ways that "robot science" can help scientists in the future.

"Worms show us what is possible: that a complex animal can restore its entire body after drastic injuries, and even defeat aging. They are a proof-of-principle that biological systems (and perhaps the robots we build someday) can be highly self-repairing. They are also cheap to raise, amenable to lots of molecular tools, and have a complex brain/behavior," senior author Dr. Michael Levin, Vannevar Bush professor of biology and director of the Tufts Center for Regenerative and Developmental Biology told *ALN* exclusively.

To develop an AI system that would help the researchers understand the mechanism behind regeneration, they developed an algorithm that used evolutionary computation to produce regulatory networks that "learned" as it predicted the results of published laboratory experiments entered into a database, according to Tufts University.

"We created a simulator in which a worm could be manipulated in a virtual world; each of the cells of this worm runs a set of rules for how the cell should act, and then we (for example) cut it, or applied gene knockdowns, etc. to see what kind of growth results." Dr. Levin continued, "We then compared that outcome to the database of real results, to see if that rule set was good or not."

Once this algorithm was successful with virtual worms, the researchers applied it to an experimental dataset of 16 key planaria experiments to see if the approach was able to identify a comprehensive regulatory network of planaria generation. The algorithm returned with the discovered regulatory network, predicting all 16 experiments correctly in the dataset. The network included seven known regulatory molecules, and included the discovery of two proteins that had not yet been identified in existing papers on planarian regeneration.

The paper represents a successful application in the growing field of "robot science." "With each day, our mountain of data grows. This makes it harder and harder to come up with models of what's going on - an increase in details that makes it more difficult to get insight. The insight is needed if we are ever going to develop ways to adjust human shape - for fixing birth defects, regenerating organs after injury, and reprogramming cancer. The problem is only going to get worse the further science goes. We simply must develop AI tools to help us make sense of all these data. Thus, our study is the first proof-of-principle that AI can help scientists not only crunch or analyze data, but to discover a theory for what the data mean and how to use them to control patterning," Dr. Levin concluded.

The researchers hope to next expand the algorithm to handle other kinds of problems, such as understanding cellular decision-making in melanoma.

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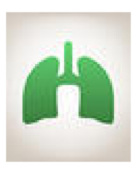

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