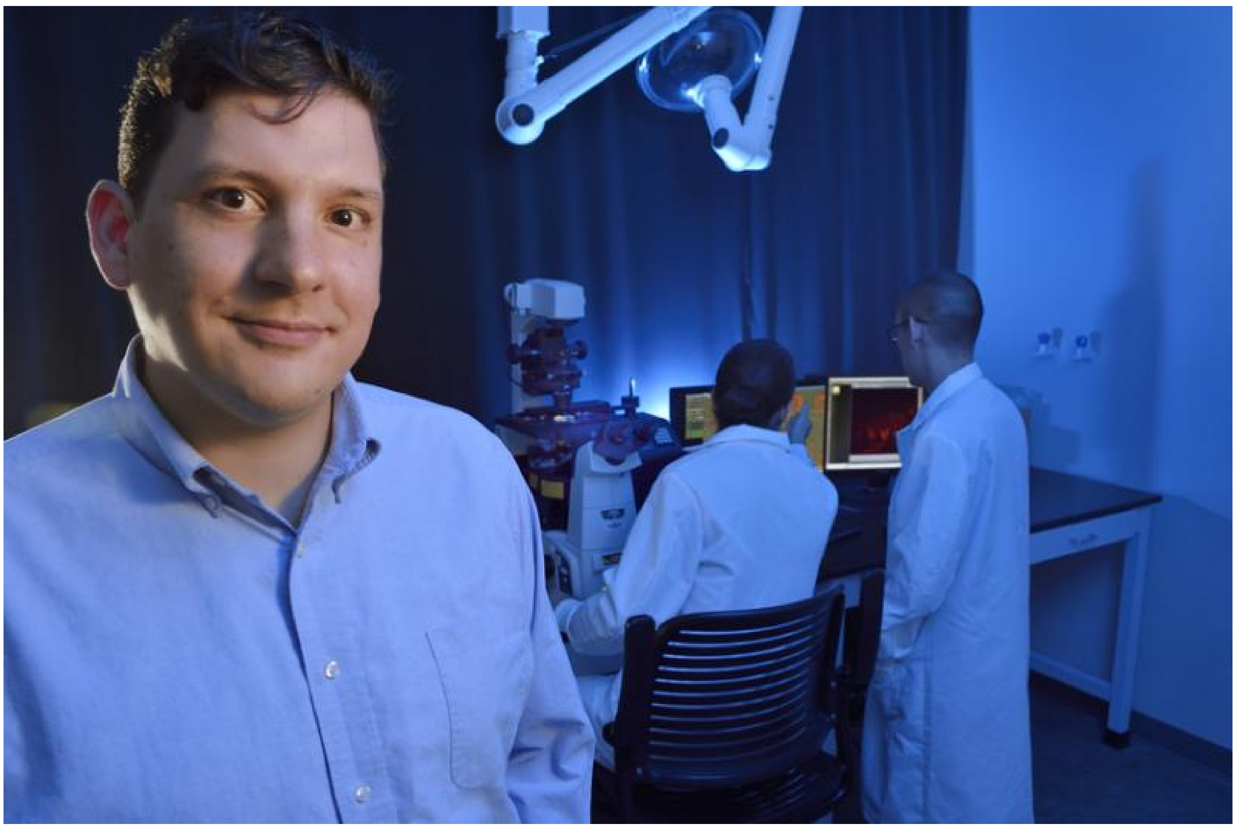
Scientist develops model for robots with bacteria-controlled brains

July 16 2015



Waren Ruder used a mathematical model to demonstrate that bacteria can control the behavior of an inanimate device like a robot. Credit: Virginia Tech

Forget the Vulcan mind-meld of the Star Trek generation—as far as mind control techniques go, bacteria is the next frontier.

In a paper published July 16 in *Scientific Reports*, which is part of the Nature Publishing Group, a Virginia Tech scientist used a mathematical model to demonstrate that bacteria can control the behavior of an inanimate device like a robot.

"Basically we were trying to find out from the mathematical model if we could build a living microbiome on a nonliving host and control the host through the microbiome," said Ruder, an assistant professor of biological systems engineering in both the College of Agriculture and Life sciences and the College of Engineering.

"We found that robots may indeed be able to have a working brain," he said.

For future experiments, Ruder is building real-world robots that will have the ability to read bacterial gene expression levels in *E. coli* using miniature fluorescent microscopes. The robots will respond to bacteria he will engineer in his lab.

On a broad scale, understanding the biochemical sensing between organisms could have far reaching implications in ecology, biology, and robotics.

In agriculture, bacteria-robot model systems could enable robust studies that explore the interactions between soil bacteria and livestock. In healthcare, further understanding of bacteria's role in controlling gut physiology could lead to bacteria-based prescriptions to treat mental and physical illnesses. Ruder also envisions droids that could execute tasks such as deploying bacteria to remediate oil spills.

The findings also add to the ever-growing body of research about bacteria in the human body that are thought to regulate health and mood, and especially the theory that bacteria also affect behavior.

The study was inspired by real-world experiments where the mating behavior of fruit flies was manipulated using bacteria, as well as mice that exhibited signs of lower stress when implanted with probiotics.

Ruder's approach revealed unique decision-making behavior by a bacteria-robot system by coupling and computationally simulating widely accepted equations that describe three distinct elements: engineered gene circuits in *E. coli*, microfluid bioreactors, and robot movement.

The bacteria in the mathematical experiment exhibited their genetic circuitry by either turning green or red, according to what they ate. In the mathematical model, the theoretical robot was equipped with sensors and a miniature microscope to measure the color of bacteria telling it where and how fast to go depending upon the pigment and intensity of color.

The model also revealed higher order functions in a surprising way. In one instance, as the bacteria were directing the robot toward more food, the robot paused before quickly making its final approach—a classic predatory behavior of higher order animals that stalk prey.

Ruder's modeling study also demonstrates that these sorts of biosynthetic experiments could be done in the future with a minimal amount of funds, opening up the field to a much larger pool of researchers.

The Air Force Office of Scientific Research funded the mathematical modeling of gene circuitry in *E. coli*, and the Virginia Tech Student Engineers' Council has provided funding to move these models and resulting mobile robots into the classroom as teaching tools.

Ruder conducted his research in collaboration with biomedical engineering doctoral student Keith Heyde, who studies phytoengineering for biofuel synthesis.

"We hope to help democratize the field of synthetic biology for students and researchers all over the world with this model," said Ruder. "In the future, rudimentary robots and *E. coli* that are already commonly used separately in classrooms could be linked with this model to teach students from elementary school through Ph.D.-level about bacterial relationships with other organisms."

Provided by Virginia Tech

Citation: Scientist develops model for robots with bacteria-controlled brains (2015, July 16) retrieved 26 April 2024 from
https://phys.org/news/2015-07-scientist-robots-bacteria-controlled-brains.html