Genetically engineered bacteria compute the route

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US researchers have created 'bacterial computers' with the potential to solve complicated mathematics problems. The findings of the research, published in BioMed Central's open access *Journal of Biological Engineering*, demonstrate that computing in living cells is feasible, opening the door to a number of applications. The second-generation bacterial computers illustrate the feasibility of extending the approach to other computationally challenging math problems.

A research team made up of four faculty members and 15 undergraduate students from the biology and mathematics departments at Missouri Western State University in Missouri and Davidson College in North Carolina, USA engineered the DNA of Escherichia coli bacteria, creating bacterial computers capable of solving a classic mathematical problem known as the Hamiltonian Path Problem.

The research extends previous work published last year in the same journal to produce bacterial computers that could solve the Burnt Pancake Problem.

The Hamiltonian Path Problem asks whether there is a route in a network from a beginning node to an ending node, visiting each node exactly once. The student and faculty researchers modified the genetic circuitry of the bacteria to enable them to find a Hamiltonian path in a three-node graph. Bacteria that successfully solved the problem reported their success by fluorescing both red and green, resulting in yellow colonies.

Synthetic biology is the use of molecular biology techniques, engineering principles, and mathematical modeling to design and construct genetic circuits that enable living cells to carry out novel functions. "Our research contributed more than 60 parts to the Registry of Standard Biological Parts, which are available for use by the larger synthetic biology community, including the newly split red fluorescent protein and green fluorescent protein genes," said Jordan Baumgardner, recent graduate of Missouri Western and first author of the research paper. "The research provides yet another example of how powerful and dynamic synthetic biology can be. We used synthetic biology to solve mathematical problems; others find applications in medicine, energy and the environment. Synthetic biology has great potential in the real world."

According to Dr. Eckdahl, the corresponding author of the article, synthetic biology affords a new opportunity for multidisciplinary undergraduate research training. "We have found synthetic biology to be an excellent way to engage students in research that connects biology and mathematics. Our students learn firsthand the value of crossing traditional disciplinary lines."

More information: Solving a Hamiltonian Path Problem with a bacterial computer; Jordan Baumgardner, Karen Acker, Oyinade Adefuye, Samuel THOMAS Crowley, Will DeLoache, James O Dickson, Lane Heard, Andrew T Martens, Nickolaus Morton, Michelle Ritter, Amber Shoecraft, Jessica Treece, Matthew Unzicker, Amanda Valencia, Mike Waters, A. MALCOLM Campbell, Laurie J. Heyer, Jeffrey L. Poet and Todd T. Eckdahl, *Journal of Biological Engineering* (in press), www.jbioleng.org/

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