Software helps synthetic biologists customize protein production

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A software program developed by a Penn State synthetic biologist could provide biotechnology companies with genetic plans to help them turn bacteria into molecular factories, capable of producing everything from biofuels to medicine.

"It's similar to how an engineer designs a plane or a car," said Howard M. Salis, assistant professor in agricultural and biological engineering, and chemical engineering. "When designing a biological organism, there are many combinations that the engineer must test to find the best combination. This technology allows us to quickly identify the best DNA sequence for a particular biotechnological application."

The program, called a DNA compiler, designs synthetic DNA sequences to control protein production inside simple organisms. Salis said narrowing down the exact genetic plans from the billions of possible sequence combinations will save biotechnology companies money and time.

To produce proteins, which are integral for creating and maintaining cells, an organism's DNA sequence controls the proteins that it makes and how much of each protein is produced.

DNA serves as a genetic template to create messenger RNA -- mRNA. Another form of RNA, transfer RNA, carries amino acids, the components of proteins, as ingredients for the proteins.

The software predicts how fast an organism will produce a specific protein. It can also design new DNA sequences to increase or decrease protein production across a large scale and to find the best protein production rates.

Salis, whose work appears in a recent issue of *Methods in Enzymology*, said that synthetic DNA sequences will play a more important role in industries as diverse as medicine and manufacturing. The biofuel industry is particularly interested in maximizing the amount of proteins produced to optimize metabolism. To be profitable, companies have to produce large quantities of biofuels.

"We're learning how to predict, control and design the behavior of biological organisms," said Salis. "We can do it much faster than evolution."

In one of the software's modes, genetic engineers can type strings of letters A, T, G and C that represent adenine, thymine, guanine and cystosine -- molecules in DNA-- into the software, which then calculates which protein will be made and how much protein will be produced, said Salis. In another mode, engineers select a protein's production rate inside the organism and the software optimizes a synthetic DNA sequence to achieve that rate.

Provided by Pennsylvania State University

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