Researchers unravel genetic web to help target diseases

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(Phys.org) —Like a complex wiring system, the genetic network within a cell is an interconnected web of strands communicating to ensure the proper function of an organism. At Rutgers–Camden, computational biologists are slowly untangling the web to understand how all the pieces fit together.

The work is a step toward understanding the regulation of gene expression, which can help scientists gain insights into genetic diseases like cancer. Genetic diseases are often caused by abnormalities in gene expression.

"If we wanted to know how a transistor radio worked, we would take it apart to see how it's all connected," explains Desmond Lun, an associate professor and chair of the Department of Computer Science at Rutgers–Camden. "That knowledge would also allow us to modify it or improve it, if we wanted to. You can think of cells in the same way. If something goes wrong, understanding how everything is connected would allow us to make it right."

Mathematical models allow researchers like Lun to study the behavior of a complex system using a computer simulation, which paints a picture of the regulatory structure of genetic networks. It helps in reverse engineering, which in this case is the process of finding which genes are controlling expression in other genes.

To find the answer, he is working with Sweta Sharma, a doctoral student in computational and integrative biology at Rutgers–Camden, on the mathematical models.

"When we study the genetic basis of diseases, we look at certain regulatory pathways," Sharma says. "Cancer pathways, for example, are not regulated properly. We can find which genes are causing abnormal regulation and therefore determine which genes should be targets for drug development to treat the diseases."

An accurate model of the behavior of regulatory networks is faster and more efficient than lab experiments and computational methods have proven to be a valuable research tool.

"This genetic network wiring diagram would be a huge breakthrough in our understanding of how human cells work," Lun says. "If we know how everything is connected, we can stick the whole system into a computer and use a computational representation of the cell to find the best ways to treat diseases. We're looking for the blueprint to allow us to achieve that."

The research is being funded by a grant from the U.S. Army Research Office. A Philadelphia resident, Lun's other research projects include calculating cell chemical reaction rates using gene expression; altering the genetic makeup of E. coli to produce biodiesel fuel derived from fatty acids; using computer modeling to more accurately analyze DNA evidence; and developing new methods to fight tuberculosis.

He earned bachelor's degrees in mathematics and computer engineering from the University of Melbourne in Australia, and received his master's degree in electrical engineering and his doctorate in computer science from MIT.

Sharma, who resides in Philadelphia, is a 2012 recipient of the Rutgers

Presidential Fellowship, a prestigious award that provides students with a stipend plus tuition and fee reimbursement. She earned her bachelor's degree from George Washington University and her master's degree from the University of New Haven.

Provided by Rutgers University