Their process begins by taking the derivatives of every computational biology. graduate student Michael Schmidt, a specialist in another changes. Then the computer creates equations at a mathematical way of measuring how one quantity changes as a variable observed with respect to every other – a random using various constants and variables from the data. It always something deeper there that is always constant, “Even though it looks like it’s changing erratically, there is always something deeper there that is always constant,” they move through clouds in interstellar space. Scientists used the COBRA … The research is published in the journal Science (April 3, 2009) by Hod Lipson, Cornell associate professor of mechanical and aerospace engineering, and graduate student Michael Schmidt, a specialist in computational biology.

The researchers have taught a computer to find regularities in the natural world that become established laws – yet without any prior scientific knowledge on the part of the computer. They have tested their method, or algorithm, on simple mechanical systems and believe it could be applied to more complex systems ranging from biology to cosmology and be useful in analyzing the mountains of data generated by modern experiments that use electronic data collection.

Cornell University doctoral student Michael Schmidt makes adjustments to an automated research system. Using the digital mind that guides a self-repairing robot, Hod Lipson, a researcher at Cornell, and Schmidt have created a computer program that uses raw observational data to tease out fundamental physical laws. The breakthrough may aid the discovery of new scientific truths, particularly for biological systems that have, until now, eluded detection. Such automation in scientific research is becoming more common, raising questions about its impact on science. (Credit: Jonathan Hiller, Cornell University)
Lipson explained. "That's the hint to the underlying physics. You want something that doesn't change, but the relationship between the variables in it changes in a way that's similar to what we see in the real system."

Once the invariants are found, potentially all equations describing the system are available: "All equations regarding a system must fit into and satisfy the invariants," Schmidt said. "But of course we still need a human interpreter to take this step."

The researchers tested the method with apparatus used in freshman physics courses: a spring-loaded linear oscillator, a single pendulum and a double pendulum. Given data on position and velocity over time, the computer found energy laws, and for the pendulum, the law of conservation of momentum. Given acceleration, it produced Newton's second law of motion. Given velocity, it found Newton's laws of motion, and for the pendulum, the law of conservation of momentum. Given position, it identified the force laws. Given acceleration, it produced Newton's second law of motion.

The researchers point out that the computer evolves these laws without any prior knowledge of physics, kinematics or geometry, but evolution takes time. On a parallel computer with 32 processors, simple linear motion could be analyzed in a few minutes, but the complex double pendulum required 30 to 40 hours of computation. The researchers found that seeding the complex pendulum problem with terms from equations for the simple pendulum cut processing time to seven or eight hours.

This "bootstrapping," they said, is similar to the way human scientists build on previous work.

Computers will not make scientists obsolete, the researchers conclude. Rather, they said, the computer can take over the grunt work, helping scientists focus quickly on the interesting phenomena and interpret their meaning.

Adapted from materials provided by Cornell University, via EurekAlert!, a service of AAAS.

Email or share this story:

Need to cite this story in your essay, paper, or report? Use one of the following formats:

- **APA**

- **MLA**

Find with keyword(s):

Enter a keyword or phrase to search ScienceDaily's archives for related news topics, the latest news stories, reference articles, science videos, images, and books.