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Complexity by way of simplicity

Peter Weiss

In his controversial 2002 book *A New Kind of Science* (Wolfram Media), theoretical physicist Stephen Wolfram proposed that traditional science is incapable of fathoming many important phenomena in nature. The complexity of how galaxies formed or what the weather will be tomorrow is too much for mathematical formulas, he asserts (SN: 8/16/03, p. 106: <http://www.sciencenews.org/articles/20030816/bob10.asp>).

Now, a team of physicists has unveiled a new way to process pattern-generating algorithms called cellular automata, which Wolfram argues are a superior way to model complex phenomena. The new study suggests that some cellular automata can be simplified substantially yet retain the essential outlines of their patterns, says Navot Israeli of the Weizmann Institute of Science in Rehovot, Israel. He and Nigel D. Goldenfeld of the University of Illinois at Urbana-Champaign describe their technique in the Feb. 20 *Physical Review Letters*.

A cellular automaton is a computational procedure for generating patterns on the basis of the relationships between like and unlike squares, or cells, of a grid. In the new work, Goldenfeld says, he and Israeli have done with automata what scientists have previously done when grappling with large groups of atoms or other particles. For example, by considering gases as ensembles of molecules instead of many individual molecules, scientists have been able to write formulas for phenomena such as temperature and pressure.

Israeli and Goldenfeld treat the cells of automata in a similar way. Starting with standard cellular-automata patterns, the researchers bunched sets of existing cells into "supercells" and then treated those supercells according to new rules. The resulting patterns tended to be fuzzier than the originals but had more predictable features, the researchers say.

This "nice, incremental improvement" offers a new method for simplifying cellular automata patterns, Wolfram comments. However, approximations of complex systems may discard important information, he cautions.

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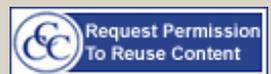
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From *Science News*, Vol. 165, No. 12, March 20, 2004, p. 189.

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