



BY RICK NELSON, EDITOR-IN-CHIEF

## Physics and economics

**Y**ou're all aware that a relationship exists between the theories of economics and electrical engineering. As the economist Charles C Holt has written with regard to his collaboration with economist AWH Phillips on control theory, "We started corresponding in the summer of 1956 about bringing the tools of operations research and electrical engineering to bear on improving economic stability." Phillips, Holt continues, "had already published several articles applying the tools

of electrical engineering to the stability of single-loop economic models," and he goes on to discuss the stabilization of economic systems incorporating multiple loops and control variables (**Reference 1**).

At press time, the economy was anything but stable, and politicians and economists have no solid proposals for stabilizing it. Economist Paul Krugman favors the US Treasury's \$700 billion bailout plan, even though he says "Treasury officials have yet to offer any clear explanation of how the plan is supposed to work, probably because they themselves have no idea what they're doing" (**Reference 2**). Might engineers or scientists have some up-to-date tools to offer economists? Mark Buchanan, a theoretical physicist, says that they do but that the economists aren't listening (**Reference 3**).

Buchanan writes that part of the problem is that economists still employ traditional equilibrium theory, which holds that market values change only in response to new information. The problem, he contends, is that "a classic economic study found that, of the 50 largest single-day price movements since World War II, most happened on days when there was no significant news." And a more recent study found

that news plays only a minor role in stock-price jumps (**Reference 4**). The authors report, "We find that neither idiosyncratic news nor marketwide news can explain the frequency and amplitude of price jumps."

The reason for the dissociation of price and information, Buchanan explains, is that markets have internal dynamics: "They're self-propelling systems driven in large part by what investors believe other investors believe ... and traders speak for good reason of the market's optimism or pessimism."

To account for such factors, he recommends the use of "agent-based" computer models that can simulate market dynamics from the bottom up. The idea, Buchanan says, is to populate virtual markets with artificially intelligent agents who represent individuals, banks, hedge funds, regulators, and other players and to study the market behavior that emerges from the actions of the interacting agents. He cites one such model, which Yale economist John Geanakoplos and physicists Doyne Farmer and Stefan Thurner are developing. The model looks at how credit levels can influence stability. They have found, Buchanan says, although cautioning that the work remains speculative, that in-

stability arrives suddenly, triggering "collective financial meltdown."

Unfortunately, he writes, economists are slow to adopt computer modeling, with one saying the use of computational models amounts to cheating. Buchanan adds, "This [resistance to modeling] seems decidedly peculiar given that every other branch of science from physics to molecular biology has embraced computational modeling as an invaluable tool for gaining insight into complex systems of many interacting parts, where the links between causes and effect can be tortuously convoluted."

I'd prefer that there be some computational evidence that my share of the \$700 billion Wall Street bailout will actually do some good. **EDN**

### REFERENCES

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- 2 Krugman, Paul, "Edge of the Abyss," *The New York Times*, Oct 3, 2008, [www.nytimes.com/2008/10/03/opinion/03krugman.html](http://www.nytimes.com/2008/10/03/opinion/03krugman.html).
- 3 Buchanan, Mark, "This Economy Does Not Compute," *The New York Times*, Oct 1, 2008, [www.nytimes.com/2008/10/01/opinion/01buchanan.html](http://www.nytimes.com/2008/10/01/opinion/01buchanan.html).
- 4 Joulin, Armand, Augustin Lefevre, Daniel Grunberg, and Jean-Philippe Bouchaud, "Stock price jumps: news and volume play a minor role," *Cornell University Library, Physics and Society*, March 12, 2008, <http://arxiv.org/abs/0803.1769v1>.

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