

Book pulls applications from abstract mathematics

January 22 2014

Mathematics can explain how light waves propagate in a fiber optic cable or that a linear flow of air over a plane's wings gives passengers a smooth ride, while nonlinear flow causes turbulence.

But pulling such real-world applications from traditional math textbooks is often a challenge.

"A lot of mathematics books are so theoretical that when we are working with engineers or physical scientists, they have trouble getting through this 'abstract nonsense'," said Wojbor Woyczynski, a professor of mathematics at Case Western Reserve University. "Abstract theory is essential to make math foolproof. But it distracts engineers and scientists from the essence of their projects."

So, Woyczynski, who earned his bachelor's and master's degrees in electrical and computer engineering, and Alex Saichev, a former professor of management, technology and economics at the Federal Institute of Technology, Zurich, embarked on a trilogy of texts to make certain abstract mathematical objects—called distributions, or generalized functions—more accessible to scientists and engineers.

Their second book, *Distributions in the Physical and Engineering Sciences, Volume 2: Linear and Nonlinear Dynamics in Continuous Media*, is now available. The volume is geared toward graduate students, researchers and advanced undergraduates, and is written in comparatively lighthearted prose for a math book.

Distributions are based largely on the work of Nobel Prize-winning physicist Paul Dirac and Fields Medal-winner Laurent Schwartz. In the book they are used to understand how:

- materials spread in a hydrogen bomb explosion;
- plankton develops, evolves and affects marine life;
- temperature is distributed in a lit detonator fuse;
- pesticides sprayed in a forest are spread when the forest is clear-cut;
- vapor condenses on a surface—essential to controlling the [chemical vapor deposition](#) process used to make such things as computer chips, optical fibers or the smooth diamond-film coating some razor blades.

"Every day we benefit from abstract math without realizing it," Woyczynski said. "But engineers and physical scientists don't have to spend years learning to live in this mathematical universe in order to operate in it."

Woyczynski's has written several textbooks about his specialties, probability and randomness. He calls this series a labor of love.

He and Saichev published the first volume in 1997, and planned the second and third volumes a decade ago. When Saichev visited Ohio four years ago, he said it was time to write the second.

Woyczynski went on sabbatical last spring and spent most of it in Switzerland, finishing the book and hiking with Saichev in the mountains.

Two weeks after the manuscript was finished and Woyczynski had returned home, he received a call that Saichev had suddenly become ill and died from blood clots in his lungs. Woyczynski added a memorial to

the book.

Woyczynski said he'll finish the third volume, with Saichev as coauthor. "We thought about the book and planned it together," he said. "It's a joint production."

Provided by Case Western Reserve University

Citation: Book pulls applications from abstract mathematics (2014, January 22) retrieved 20 March 2024 from <https://phys.org/news/2014-01-applications-abstract-mathematics.html>

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