Modeling capitalism in the 21st century

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European editor

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***Wolfgang Breymann (WB)** is a professor of financial mathematics at the Zurich University of Applied Sciences and has also spent three years as a senior researcher at ETH Zurich's RiskLab. In addition, from 1998-2000 Breymann worked with Olsen Ltd, which pioneered methods for collecting high-frequency data and building algorithmic trading models.*

***Kurt Stockinger(KS)** is an associate professor of computer science at the Zurich University of Applied Sciences and has previously worked at the European Organization for Nuclear Research (CERN) and the Lawrence Berkeley National Laboratory in the US, as well as in the banking sector in Switzerland.*

Breymann and Stockinger are investigating the big-data challenges that arise when designing large-scale massively parallel financial simulations. In an in-depth interview with iSGTW, *they discuss the role cloud-based high-*

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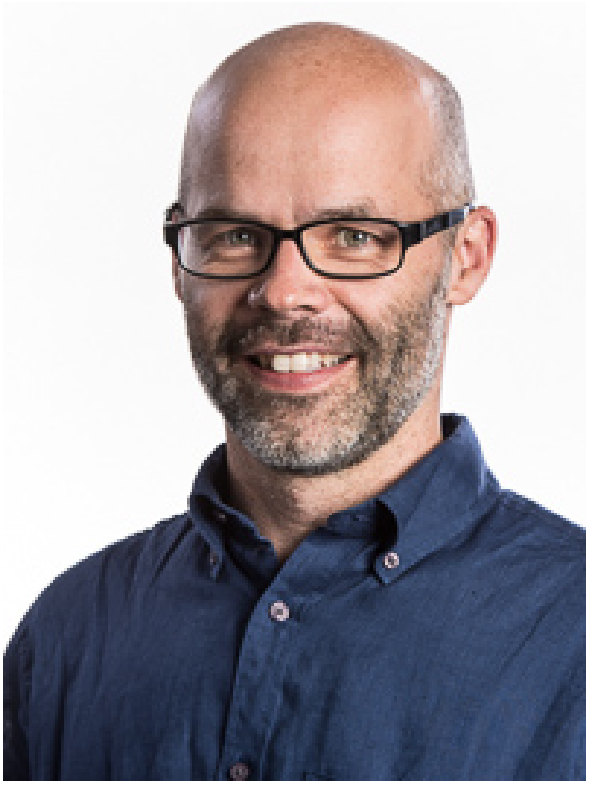
performance computing (HPC) resources can play in solving this big-data challenge and thus in successfully identifying potential weak points in today's global financial system.



"Many of the types of calculations used in physics can also be used in the financial world: you just crunch numbers for financial analysis rather than numbers relating to particles," says Stockinger. "The methods used are actually often very similar."

Given the sheer size and complexity of our global financial system, is it really possible to do any meaningful modeling?

WB: Weather is also very complex, yet there are useful weather models. Our aim is simply to create the pre-conditions for efficient modelling of financial systems: essentially, this means setting standards.

KS: The global financial system is estimated to consist of billions of financial contracts. To simulate the future cash flows of these contracts and possible future macro-economic scenarios, stress tests and Monte-Carlo methods are typically used. In order to attain reasonable statistical precision, a simulation should contain thousands of possible scenarios, which results in petabytes of so-called 'basic analysis data'. Analyzing these tremendous amounts of data requires highly-scalable big-data analytics.

So, the key to a more complete understanding of our global financial system is establishing data standards then?

WB: Online weather forecasts are updated at least every couple of hours, but the data chaos in the financial world means that banks often lag behind with their simulations and do not know their own real-time status. All too often, apples are being compared with oranges: for example, the use of different software systems within the same bank frequently results in major inconsistencies. From a technological point of view, banks should be able to do all of this reasonably quickly and easily. Major banks have some of the world's fastest supercomputers, but from the perspectives of efficiency and standardization, they are still languishing in the 19th century.

KS: Today, every large bank has its own big-data warehouse. They all model the use of various financial instruments, but they all do it differently. In high-energy physics, there are standardized data

models that mean everything works together pretty well, but this is certainly not the case with banks. It's currently impossible to compare the results different banks obtain from their financial models, which is why we really need a standardized data model.

"There is also a fundamental lack of cooperation in the banking world," says Breymann. "It's not like in the scientific research community where groups and individuals often work together for a common cause. Banking is probably the most competitive business in the world and secrecy plays a major role."

What do you believe to be the reasons behind this lack of standards in the world of finance and banking?

KS: At large scientific laboratories like CERN there's also a huge amount of data, but it's often all coming from one primary data source: in the case

of CERN, the Large Hadron Collider. By contrast, the banks are dealing with data from hundreds upon hundreds of different sources. Data from all of these sources needs to be integrated, but each source has different attributes and uses slightly different nomenclature. So, the problem here is less one of data processing *per se* and more one of integration and standardization. We need to get everyone to speak the same language with their data.

WB: There is also a fundamental lack of cooperation in the banking world. It's not like in the scientific research community where groups and individuals often work together for a common cause. Banking is probably the most competitive business in the world and secrecy plays a major role.

What progress have you made so far in your efforts to establish a standardized data model?

WB: We estimate that a typical large bank has a few hundred million financial contracts. Through the ACTUS project, we are developing a standard model for algorithmic representation of financial contracts.

KS: Yes, there are millions of different financial instruments in use around the world, but these can be simplified down to about just 30 different basic types (bonds, stocks, savings accounts, *etc.)*. Wolfgang and his team have already started work to standardize 12 of these.

WB: Once half of these 30 have been standardized, we should be able to model over three-quarters of the global financial market.

KS: Through our work, we've brought together the economists, the computer scientists, and the financial systems analysts, all of whom speak very complex and very different languages. With our model, we've identified how we can parallelize this problem and how we can eventually go about solving it from a big-data perspective.

Read more about HPC in the world of finance in iSGTW's feature article 'Keeping an eye on superfast transactions on Wall Street'. Image courtesy StockMonkeys.com, Flickr (CC BY 2.0).

What big-data analytics methods are you using to study the global financial market?

KS: We use stress tests and Monte Carlo simulation to model various cash-flow scenarios for financial instruments. And, the more scenarios (often up to 1,000) we calculate for a given instrument, the more data we get out of the simulation. This is a classic case of an embarrassingly parallel problem.

And what's the role of cloud computing in all of this?

KS: If you work for a company and want to simulate the financial risks you face, there are two options: you can either buy your own HPC infrastructure or you can use HPC resources elastically via the cloud.

Okay, but Wolfgang spoke earlier about the importance of secrecy in banking... so what about issues of security and trust in relation to using cloud?

KS: Security is, of course, a key concern for banks, but it's important to remember that cloud computing isn't just about public clouds. Banks could alleviate many of the security concerns by using private cloud resources to run the simulations or perhaps national banks could run the cloud resources on behalf of the individual banks.

WB: Yes, there are several solutions to the security problem. We could even see the rise of trusted private companies providing specialized high-security HPC centers for financial simulation. Such specialized third-party centers already exist for weather forecasting.

Finally, Kurt, you've alluded a couple of times to how working with financial data compares to dealing with scientific data from large physics experiments. How did your work at CERN with the European

DataGrid project **- the precursor to** the Enabling Grids for E-Science **and** EGI Inspire **projects - prepare you for tackling the complexities of the global financial market?**

KS: In the high-energy physics community, the data is actually pretty 'clean'. However, in the world of finance it's completely different: the data doesn't come out of carefully designed particle detectors, but rather it comes from humans working in hundreds of different areas. As such, our work with the financial markets is really much more about standardization and data integration, rather than understanding.

On the other hand, many of the types of calculations used in physics can also be used in the financial world: you just crunch numbers for financial analysis rather than numbers relating to particles. The methods used are actually often very similar.

Kurt Stockinger gave a presentation about this work at the recent ISC Big Data event in Heidelberg, Germany. Read more about this conference in our full roundup article, here.

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