

Mathematics for safer medicine

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Natural sciences continuously produce larger and more complex data sets – using elaborate sensor technology or computer simulations. But can researchers be sure that the results of their computer simulations are reliable and accurate enough even if some aspects of the system under consideration are not exactly known? The new research group "Data Mining and Uncertainty Quantification" at the Heidelberg Institute for Theoretical Studies (HITS) wants to shed light on this question. With Prof. Vincent Heuveline as group leader, six researchers focus on the analysis of large data sets and on the calculation of uncertainties within technical systems. They use state-of-the-art technology from the areas of High Performance Computing and Cloud Computing.

"Today's computing power allows us to analyze and determine the quality of a calculation, by including a characterization of uncertainty", says group leader Vincent Heuveline who is a professor at Heidelberg University. "We can therefore develop new scientific methods which add a new twist to the old philosophical question: 'What is certain?'."

The research group has chosen operating rooms as a key application area. "Nowadays, operating rooms are as well-equipped as a cockpit with its numerous technical instruments," Heuveline explains. The instruments continuously generate a large amount of data so that the surgeon knows about the patient's condition and the status of the devices. "Surgeons must be able to fully rely on their instruments, just like pilots", Heuveline says. "We want to make sure they can do so." The HITS researchers analyze the technical systems, simulate surgical procedures including their impact on the body of the patient, and also

calculate the probability of an error occurring during the simulations. "The results of our observations will be integrated into the IT infrastructure of the operating room and make the systems even more reliable."

The research group maintains a close relationship with the University of Heidelberg, which is illustrated by the overall organization. Besides his professorship, Vincent Heuveline also works as director of the university's computer center, where he and 85 employees are responsible for the IT infrastructure of Germany's oldest university, from e-mail accounts to high-performance computers. He also heads a research group at the university, the "Engineering Mathematics and Computing Lab" (EMCL) at the Interdisciplinary Center for Scientific Computing.

Provided by Heidelberg University

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