What Success Creates

Fishing in a Sea of Data

Bayer Technology Services and the RWTH Aachen University in Germany intend to build a Joint Research Center for Computational Biomedicine. One of the two managers in charge of this exciting project is Professor Andreas Schuppert.

October 9, 2012 is a date Professor Andreas Schuppert will never forget. It is the day Dr. Dirk Van Meirvenne, Managing Director of Bayer Technology Services in Leverkusen, and Professor Ernst Schmachtenberg, Rector of the RWTH Aachen University, announced their intention to establish a Research Center for Computational Biomedicine at the RWTH Aachen University. Two experts are to be in charge of this new institution. A worldwide search is currently underway to find one of the managers, but the other expert is a well-known and highly regarded personality at the RWTH Aachen: Andreas Schuppert.

With this appointment the key expert for industrial mathematics is one major step closer to realizing his lifelong ambition. In addition to his position at Bayer Technology Services, for several years now the 55-year-old German has been working two days a week as a university professor at the Aachen Institute for Advanced Study in Computational Engineering Sciences. His assignment there is to develop models for systems biology and biomarkers for clinical diagnostics and to monitor biological processes. With this new responsibility, his sphere of activity will now be considerably broadened. The main goal of the new joint venture is to develop new methods in the field of computer-based modeling of complex biological processes.

“With these particular research efforts, we do not only want to help shed light on basic physiological processes,” says Schuppert. Their foremost intention is to contribute to providing a better understanding of diseases and the effect of drugs. “With this approach new active pharmaceutical ingredients can be developed faster and applied in a more targeted manner during therapy.”

In simple terms, the aims of systems biology are to predict the development of diseases already at an early stage and to treat patients more individually and more directly. This still relatively young field combines biology, biochemistry, physics, chemistry and medicine with informatics, mathematics and engineering sciences to achieve an interdisciplinary research approach.

The task is quite ambitious: in systems biology it is a question of understanding and modeling the complex and dynamic processes of a cell or an organ – for example, when it comes to environmental adaptability, aging or immunological defenses. The vast amount of data on individual cell components and cell functions, gathered at various levels of life processes, must be put in a meaningful overall context and modeled on the computer so that simulations and forecasts are possible without laboratory experiments.

The first scientists to pursue this idea were British neurophysiologists Alan L. Hodgkin and Andrew F. Huxley. With their mathematical model of a nerve cell, they laid the foundation for the simulation of life processes, and as a result, they are regarded as the pioneers of systems biology. In 1963 they were awarded with the Nobel Prize for their fundamental findings.

After coming up with this first model, however, it took another five decades before systems biology’s real wave of de-

Tasks for the future

Anti-tumor drugs do not work in the same way with all patients and all tumors. Another shortcoming of these medicines is that as yet it has not been possible to predict whether they have any effect at all – even if there is sufficient data available based on cell cultures and animal experiments.

As part of the MEDSYS research collaboration, supported by the German Ministry for Education & Research, Bayer Technology Services, Bayer HealthCare, RWTH Aachen and the German Cancer Research Center may be close to a solution thanks to a new process. Each member of the consortium contributed its own specific know-how to this development.
In collaboration with his work groups, Schuppert handles this gigantic sea of data to which immense quantities of further information are added every day. Their common goal is to develop filters that can sort out the relevant information from this vast amount of data. “The big trick is to set up these filters.” These data are expected to provide vital information on how cells react – for instance to external stress. In addition, it is hoped they will be able to offer important details of the actual behavior of cells and to shed light on how they reprogram themselves.

Professor Andreas Schuppert has perfectly mastered the art of data mining. The researcher with a PhD in mathematics studied physics as well. But he also attributes a large portion of his success to his studies of business administration. “In economics you learn there is not only one right way, because it is the logical one, but rather that there are many possibilities.” When translated into his daily work, this means you have to be mindful of the different challenges offered by the various life sciences. After all, “biology deals with completely different questions than physics or mathematics”. In other words, it takes many individual parts to make a complete picture.

So, what does Schuppert think is the biggest challenge in the near future? His answer does not require long deliberation: “We have to learn to understand how cells react to external stress and how they can be reprogrammed. When we know these answers, we can then explain how drugs take effect.” And these findings will result in a “whole bunch of new applications that we have only come up with so far through trial and error”.

The new research center in Aachen is set to start with 10 scientists and will then be rapidly expanded until 2018. It will be associated with both Modeling and Simulation Research at the RWTH Aachen as well as with the medical faculty of the university. In this constellation, the Center for Computational Biomedicine clearly fills a gap in the research landscape. There are only a few comparable collaborations anywhere else in the world that can boast such a wide spectrum of competence and experience in the implementation of basic research into practical application.

“This research is helping to shed light on basic physiological processes.”

Professor Ernst Schmachtenberg, Rector of RWTH

Professor Andreas Schuppert