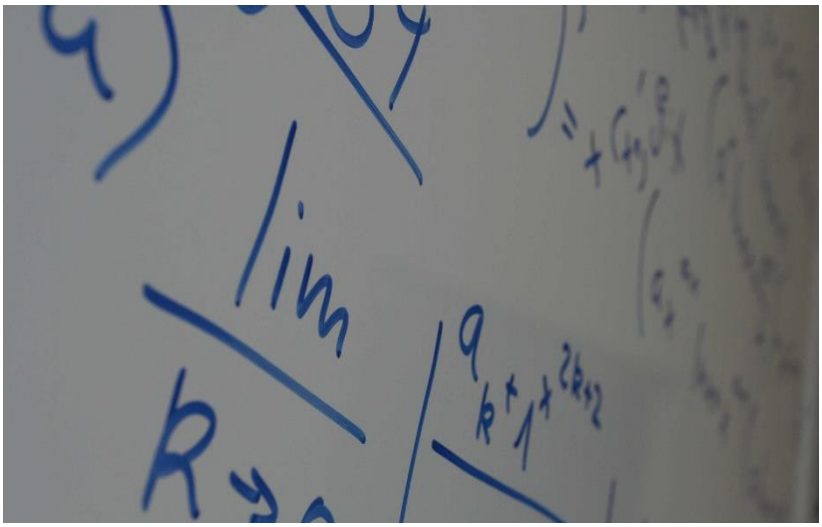
Data Analysis: Uncertainty as a Source of Information

Helmholtz Association Funds 4-million-euro Project to Improve the Handling of Uncertainties in Data Volumes and Strengthen Data Competences



Uncertainty quantification gives rise to data science tools that use uncertainty as a source of information. (Photo: Markus Riecker, KIT)

Monika Landgraf
Chief Press Officer,
Head of Corp. Communications

Kaiserstraße 12
76131 Karlsruhe, Germany
Phone: +49 721 608-21105
Email: presse@kit.edu

Press contact:

Kosta Schinarakis
Press Officer
Phone: +49 721 608-21165
Email: schinarakis@kit.edu

Rapidly growing data volumes open up possibilities to master challenges of society, science, and industry. However, data and analyses are subject to uncertainties in practice. These can be turned into a source of information by probability theory methods. Within the project "Uncertainty Quantification – From Data to Reliable Knowledge," users and mathematicians of Karlsruhe Institute of Technology (KIT) and nine other institutions collaborate to gain reliable findings from large data volumes and develop applicable tools. The project will be funded by the Helmholtz Association for the next three years.

"Especially when handling issues of public interest, such as climate change, energy supply, and personalized medicine, quantification and understandable communication of probabilities, chances, and risks are indispensable," says Professor Martin Frank of KIT. He is Director of the Steinbuch Centre for Computing (SCC) of KIT and Spokesman of the KIT Center MathSEE (Mathematics in Sciences, Engineering, and Economics). "We consider it absolutely necessary

to understand uncertainties and want to strengthen data competence of researchers with our projects." The project "Uncertainty Quantification – From Data to Reliable Knowledge" was successful in the competition for funding in the area of Information & Data Science of the Helmholtz Incubator. The project combines the development of methods and tools to handle uncertainties in data volumes with their communication.

Using appropriate probabilistic, i.e. probability theory, methods of data science, uncertainty is a valuable source of information and enhances black box approaches, such as artificial intelligence. To use these advantages, the project's point of departure is the interface of applications and mathematics. It is aimed at enabling reliable knowledge gains from data by developing widely usable uncertainty quantification tools and methods based on concrete cases of application.

Data Science for Climate, Energy, Health, and Information

The project connects researchers from the Helmholtz Association's four research fields of Earth & Environment, Energy, Health, and Information as well as Helmholtz data scientists and external university partners focusing on mathematics and econometrics. An example of future project topics is renewable energy and its volatile contribution to energy supply. Planning and operation of future energy systems requires reliable quantification of uncertainties of the shares. Another example are climate projections that are based on complex simulation models into which erroneous measurement data are input. Exact quantification of uncertainties allows for a better analysis and communication of climate change.

With the help of the tools and methodological approaches developed, scientists will be able to extract reliable knowledge from uncertainty, while traditional approaches and software fail because of the rapidly growing data volumes and their high variability. The project will be funded by the Helmholtz Association with EUR 2 million, another 2 million euros will be provided by the institutions involved. It will be coordinated by Professor Martin Frank, KIT, and Professor Christiane Fuchs, who teaches and conducts research at the University of Bielefeld and the Helmholtz Zentrum München – German Research Center for Environmental Health.

Helmholtz Information & Data Science Incubator

The Helmholtz Information & Data Science Incubator is a long-term, Helmholtz-wide bottom-up process that pools the vast expertise of the Helmholtz Association in the area of information and data science. It supports pilot projects using innovative approaches and researchers working across Helmholtz centers and research fields. Information & Data Science covers methods and technologies to gain knowledge from complex, short-lived or weakly structured big data along the entire data lifecycle.

More about the KIT Center "Mathematics in Sciences, Engineering, and Economics" (MathSEE):
https://www.mathsee.kit.edu/english/index.php

Being "The Research University in the Helmholtz Association," KIT creates and imparts knowledge for the society and the environment. It is the objective to make significant contributions to the global challenges in the fields of energy, mobility and information. For this, about 9,300 employees cooperate in a broad range of disciplines in natural sciences, engineering sciences, economics, and the humanities and social sciences. KIT prepares its 25,100 students for responsible tasks in society, industry, and science by offering research-based study programs. Innovation efforts at KIT build a bridge between important scientific findings and their application for the benefit of society, economic prosperity, and the preservation of our natural basis of life.

This press release is available on the internet at http://www.sek.kit.edu/english/press_office.php.

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This year's **anniversary logo** recalls the milestones reached by KIT and its long tradition in research, teaching, and innovation. On October 1, 2009, KIT was established by the merger of its two predecessor institutions: the Polytechnic School and later University of Karlsruhe was founded in 1825, the Nuclear Reactor Construction and Operation Company and later Karlsruhe Research Center in 1956.