Technology Assessment: Artificial Intelligence in the Medical Sector

Precise Medicine with Side Effects: Project Analyzes Opportunities and Challenges of Combining Artificial Intelligence with Modern Human Genomics and Genome Editing

Treating diseases and "improving" genetic material: KIT researchers investigate potential contributions of AI and the resulting ethical problems. (Photo: Pixabay)

Decoding of the human genome still poses puzzles that might be solved with the help of artificial intelligence. New therapeutic approaches to treating severe diseases appear possible as do non-medical "improvements" of the genetic material. With funds of the Federal Ministry of Education and Research (BMBF), technology assessment experts of Karlsruhe Institute of Technology (KIT) study which applications are realistic and which ethical issues they may entail.

"Modern genome research works on understanding and predicting how genetic differences between human beings determine complex features, such as predispositions to frequent diseases," says Harald König of KIT's Institute for Technology Assessment and Systems Analysis (ITAS). Although genome analysis potentials progress rapidly, the knowledge of how our genetic material determines such characteristics is mostly limited to correlations. Use of advanced types of machine learning now promises to result in a decisive advancement. "So-called deep learning in particular might enable not just reading of human genomes as before, but also understanding of the complex biophysical relationships and mechanisms that turn genetic predispositions into physical characteristics," König adds.

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:

Jonas Moosmüller
Public Relations, ITAS, KIT
Phone: +49 721 608-26796
Email: jonas.moosmueller@kit.edu

Effective Therapies against Cancer or Dementia

The new approaches are based on combining artificial intelligence with rapidly progressing genome analysis techniques (including single cell analyses) and automated laboratory platforms. The latter may supply large amounts of data on genome modifications and various cellular processes, such as reading of genes or the occurrence of different protein types under various conditions. “This might result in a big leap of understanding – from correlations to causal relations – that promises to open up entirely new applications,” Harald König says. It gives rise to hope for new, much more effective therapies of cancer, cardiovascular diseases or dementia. “Precision medicine” of this type might be adapted to groups of patients, disease variations, or disease stages.

The team that consists of technology assessment experts of KIT and researchers of the Fraunhofer Institute for Systems and Innovation Research ISI plans to analyze practical applications that will be realistic in the short and medium terms. Moreover, research will focus on the wide range of social and political implications of this new knowledge. Future medicine, for instance, might have enormous macroeconomic and social benefits for an aging society. Some approaches, such as gene- and cell-based therapies, however, might be associated with very high costs, thus raising questions regarding the funding of research and development and accessibility by patients.

Preventive Interventions in the Human Germline

The knowledge of which genetic information would have to be “rewritten” to achieve certain effects and latest genome editing methods, such as CRISPR-Cas, also give rise to ethical questions. The international trend might be to go beyond rare hereditary diseases and to prevent also widespread diseases, such as breast cancer or diabetes, by a “preventive correction” of the corresponding risk mutations in the germline of human embryos. “In the extreme case, this development might result in a growing acceptance of ‘improvements’ of the human genome by non-medical interventions,” Harald König says.

Moreover, society has to deal with property rights of genetic data and data security issues. In future, it might be possible to draw conclusions with respect to the phenotype, e.g. the looks of a person, from genome sequences. “This knowledge,” König says, “would be highly valuable not only for law enforcement authorities.”

Options for Political Decision-makers

Based on their technology assessment, the researchers plan to develop options for research and innovation policies in the next two years. They want to offer political decision-makers various action options for responsible handling of this AI- and genomics-driven technology.

The project “Deepen Genomics – Opportunities and Challenges of the Convergence of Artificial Intelligence, Human Genomics, and Genome Editing” is part of the Innovation and Technology Assessment (ITA) Program of the Federal Ministry of Education and Research (BMBF). Current research projects under the Program will be presented at the ITA Forum 2019 in Berlin on February 14 and 15.

More Information:

http://www.itas.kit.edu/english/iut_current_koen19_deepgen.php

https://www.bmbf.de/de/innovations-und-technikanalysen-ita-937.html (in German only)

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.

The photo may be downloaded under https://pixabay.com/de/dna-erbgut-helix-proteine-biologie-3539309/

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.