Tokyo Tech Research Units

BioMedical AI Research Unit

Overview

Deep learning in the field of artificial intelligence (AI) has been garnering attention as an innovative technology in the circles of both academia and industry. Deep learning is being studied and applied throughout the world to bring about the Fourth Industrial Revolution. Its applications in biomedical fields in particular have been designated as a priority in several countries due to its growth and future potential. Deep learning has also received significant attention from industry because of the rapid expansion of the market scale. The BioMedical AI Research Unit (BMAI) is working to develop new AI fundamental technologies that advance current deep-learning methods, and to promote its applications in the biomedical fields (diagnostic support, imaging, etc.) and their translation in clinical practice.

Research Goals

Deep learning is revolutionizing various fields. Things which were not possible with conventional technologies are now achievable, and performance levels that could not previously be reached are now attainable. Simply by providing big data, deep learning can automatically study a problem and produce a final result. Applications of deep learning to biomedicine, however, are hindered by the following major problems: 1) It is difficult to apply deep learning in the areas where acquiring big data is difficult; 2) since a deep-learning model learns everything automatically, the model becomes a "black box;" and 3) since deep learning is data-driven, there is no methodology for designing the model in accordance with requirements. This research unit will develop next-generation deep-learning platforms that solve these problems, and it will promote their biomedical applications and implementations in clinical practice. The research unit will conduct these activities through collaborations with medical schools and industry, while it will also educate and produce world-leading talents in AI.

Research Unit Leader **Kenji Suzuki**

Profile

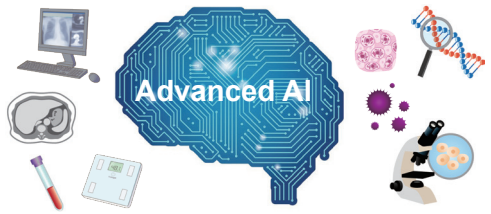
2021 Professor, Institute of Innovative Research, Tokyo Institute of Technology
2017 Specially Appointed Professor, Institute of Innovative Research, Tokyo Institute of Technology
2014 Associate Professor, Medical Imaging Research Center, Illinois Institute of Technology
2007 Assistant Professor, Graduate Program in Medical Physics, The University of Chicago (joint appointment)
2006 Assistant Professor, Department of Radiology, The University of Chicago
2004 Research Associate (Assistant Professor), Department of Radiology, The University of Chicago
2002 Research Associate, Department of Radiology, The University of Chicago
2001 Visiting Research Associate, Department of Radiology, The University of Chicago
2001 PhD in Engineering, Nagoya University

BioMedical AI Research Unit

Biomedical Applications

Medicine
Exam, detection, diagnosis, treatment, prognosis

Healthcare
Prevention, monitoring, pre-symptom, indications



Biology
Structure, function, classification, discovery, clarification

Advanced AI Technologies

- Explainable AI (XAI)
- Small-Data AI (sdAI)
- Human-AI Cooperation
- Engineerable AI (eAI)
- AI Imaging (AI^2)

AI research, development, applications, implementations

Modeling, construction, learning, design, analysis, explanation, evaluation, certification

Establishing next-generation deep learning and realizing its use in AI-based biomedicine

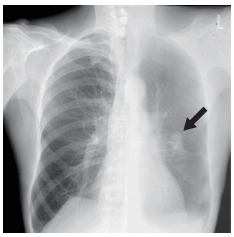
Q What are the strengths of this research unit?

In the BioMedical AI Research Unit, by utilizing our knowledge, skills, and know-hows of deep-learning research and implementations in medicine over the last 25 years, we will develop next-generation deep-learning models that solve the problems of current deep learning. We will also promote research, development, and applications of biomedical AI. There are countless research organizations throughout the world that apply existing deep-learning models to their own fields. However, there are few research organizations that develop brand-new deep-learning models from scratch. Furthermore, even on a global level, it is rare for these research organizations to bring brand-new models to real-world applications. Our research unit will achieve such goals through joint research with physicians, researchers, and companies, within Japan as well as abroad.

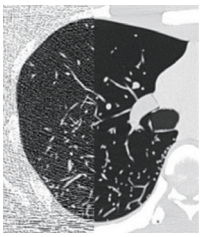
Q What is the path to achieving the unit's goals?

The three major problems with current deep learning mentioned earlier will be solved in the national research projects of the NEDO and JST. 1) Our original deep-learning model can learn from a relatively small amount of data. We will generalize this unique learnability to build new general models that can learn from small amount of data. 2) We will generalize our pioneering "white box" technology to explain deep-learning models. 3) We will generalize our pioneering methodology for designing deep-learning models. By using these new fundamental AI technologies, we will promote the real-world implementations of biomedical AI in diagnostic support and medical imaging.

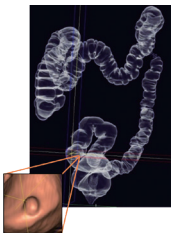
AI Imaging and AI-assisted Diagnosis



Removal of bone components and detection of a lung cancer (arrow) using our AI imaging



Virtual high-dose CT made from ultra-low dose CT using our AI imaging



Polyp detection from the image of the colon using our AI-assisted diagnosis

Q What impact will the unit's research have on society?

Since the AI technologies we are developing can solve the fundamental problems of deep learning, their applications are expected to become a global trend with a significant academic impact. Graduate students, researchers, and engineers who participate in this AI research are expected to become leaders in the AI fields and play important roles throughout the world. The applications of our new fundamental AI technologies in the biomedical fields and their implementations will contribute greatly to the global market, which is forecasted to grow to several trillion yen by 2025. In addition to the AI field, this work will also contribute to developments in the fields of medical sciences and healthcare. Their implementations are expected to reduce morbidity and mortality rates, and to improve people's health.

Contact us

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