Progress report 2024

Course Title: Cardiovascular Medicine AI Group

Representative: Satoshi Kodera, Project Lecturer, Department of Cardiovascular Medicine Member: Shinnosuke Sawano, Project Clinical Physician

Course Overview

Our laboratory aims to realize next-generation support systems through clinical the integration of medicine and AI technologies. In particular, we are advancing the development of large language models (LLMs), generative AI, and multimodal AI to diagnostic enhance support, improve efficiency, facilitate operational and information sharing in clinical settings. We focus on building AI models that can be practically applied in real-world healthcare by integrating various types of medical data, including electrocardiograms (ECG), X-rays, echocardiograms, blood tests, and electronic medical records. We are also preparing for social implementation through consultations with the PMDA and clinical trials. Leveraging a collaborative research network with medical institutions across Japan, we promote the collection and utilization of large-scale, diverse medical datasets. Through interdisciplinary integrating research medicine, information science, and ethics, we strive to improve both the quality and sustainability of healthcare.

Research Activities

Our laboratory develops diagnostic support models using multimodal AI based on data such as electrocardiograms, X-rays, echocardiograms, coronary angiography, blood tests, and electronic medical records. For example, we are working on AI systems that assist in the early diagnosis of conditions such as heart failure, pulmonary hypertension, myocardial infarction, acute aortic dissection, and pulmonary embolism. We are also developing large-scale generative models for automatic report generation. By applying techniques such as Masked Autoencoders and CLIP, we achieve high-precision feature extraction from videos and images. Furthermore, we are engaged in safety and efficacy validation in anticipation of clinical implementation and consultations with the PMDA, as well as evaluating social acceptance among healthcare professionals and the general public. Our research covers the full spectrum from foundational studies to deployment, practical promoting comprehensive advancement in medical AI.

■ FY2024 Publications & Books

1. Kishikawa R, Kodera S, Setoguchi N, Tanabe K, Kushida S, Nanasato M, et al. An ensemble learning model for detection of pulmonary hypertension using electrocardiogram, chest X-ray, and brain natriuretic peptide. European Heart Journal -Digital Health. 2025.

2. Shinohara H, Kodera S, Nagae Y, Hiruma T, Kobayashi A, Sato M, et al. The potential of the transformer-based survival analysis model, SurvTrace, for predicting recurrent cardiovascular events and stratifying highrisk patients with ischemic heart disease. PLoS One. 2024;19(6):e0304423.

3. Sawano S, Kodera S, Setoguchi N, Tanabe K, Kushida S, Kanda J, et al. Applying masked autoencoder-based self-supervised learning for high-capability vision transformers of electrocardiographies. PLoS One. 2024;19(8):e0307978.

4. Baba K, Yagi R, Takahashi J, Kishikawa R, Kodera S. JRadiEvo: A Japanese Radiology Report Generation Model Enhanced by Evolutionary Optimization of Model Merging. arXiv preprint arXiv:241109933. 2024.