先端科学技術研究科　修士論文要旨

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論文題目	Future morphology prediction: Using machine learning models to simulate the development of organ samples 将来の形態予測: 機械学習モデルを使用してオルガノイドの発達をシミュレーションする		

要旨

In this article, we take an in-depth look at advances in organoid research. Organoids are miniature organ models derived from stem cells in a laboratory setting. These micro-organs mimic the key functions and structures of organs within the human body and morphological changes over time. Therefore, using advanced computer-generated techniques to simulate the potential future forms of these organoids is crucial for scientists working in the fields of regenerative medicine and organ engineering. In particular, we focus on a diffusion model-based video prediction method to predict the morphological structural changes of organoids.

To achieve this goal, we conducted extensive experiments on more than 7000 different organoid samples, applying three main machine learning models related to spatiotemporal prediction and image generation: convolutional long short-term memory network (convLSTM), Generative adversarial networks (GAN) and diffusion models. These models are trained to predict organoid morphological changes over time and generate corresponding image data. By comparing their performance on two key performance indicators: mean square error (MSE) and structural similarity index (SSIM), we found that the diffusion model of generative artificial intelligence performed well among many prediction models, showing its performance in prediction categories. High-precision capabilities in organ morphological changes.

In addition, our study not only provides a new perspective and methodology for organoid morphology prediction, but also opens up a new path for future regenerative medicine and tissue engineering research. By combining machine learning technology with biomedical research, we can more effectively simulate and predict the development and pathological processes of human organs, providing a new tool for future medical research.

Keywords: organoids, machine learning, image generation, diffusion model