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Which way will cells move next? — Predicting the future direction of cell movement with AI —

A group comprising Mr. Shori Nishimoto (at the time), Associate Professor Akira Funahashi, Mr. Yuta Tokuoka, and Research Associate Takahiro Yamada of the Keio University Faculty of Science and Technology, Department of Biosciences and Informatics, and Professor Noriko Hiroi of the Sanyo-Onoda City University developed an AI system that can predict the future directions of cell movement from current cell images. The AI does this by taking advantage of a property of cells that cause them to change shape before migrating. As a result, it was shown that when future directions of cell movement of mouse fibroblast cells, etc., were classified into 4 directions (upper left, upper right, lower left, and lower right), the implemented AI could make predictions with an accuracy of 80% or higher. Furthermore, when features of the images learned by the AI were examined, it was found that predictions of future directions of cell movement were based on cell protrusions known to form at the leading edge of the cells when they migrate and the characteristic shape of the cell trailing edge, clarifying that the AI was making predictions based on biological evidence. These results show that AI is useful for predicting future states from current cell images, and applications are expected in fields such as medical care, where the diagnosis and prognosis of cancer, etc., strongly require future predictions.

The outcomes of this research were published in the online version of the academic journal PLOS ONE on September 4 (Wed.), 2019 (US time), ahead of its publication in the printed version of the same journal.

Future developments

The outcomes of this research showed that an AI system based on convolutional neural networks (CNN) can predict future directions of cell movement with high accuracy from current cell images. Additionally, by analyzing in detail the features used by the AI for the predictions, it was found that the predictions of future directions of movement are based on features related to cell migrations confirmed up to now through molecular biology. In other words, it can be said that the AI is not just completely memorizing the given images and returning the directions of movement based on this, but is predicting the directions of movement after automatically finding the critical structures for cell migration from the images. Although only predictions of directions of movement have been accomplished at present, the potential ability to predict future states from current cell images is expected to have applications in fields such as medical care, where there is a strong requirement for future predictions, for example, in the prognosis of cancer.

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