

Interpretable deep learning of label-free live cell images to uncovers functional hallmarks

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Technology

Dr. Zaritsky and his colleague, Prof. Gaudenz Danuser (Southwestern Medical Center, Dallas, Texas), developed interpretable deep learning of label-free live cell images to uncovers functional hallmarks of highly metastatic melanoma. They demonstrated that the latent features extracted from label-free live cell images by an adversarial auto-encoding deep convolutional neural network capture subtle details of cell appearance that allow classification of melanoma cell states, including the metastatic efficiency of seven patient-derived xenograft models that reflect clinical outcome. Although trained exclusively on patient-derived xenograft models, the same classifier also predicted the metastatic efficiency of immortalized melanoma cell lines suggesting that the latent features capture properties that are specifically associated with the metastatic potential of a melanoma cell regardless of its origin. They used the autoencoder to generate “in-silico” cell images that amplified the cellular features driving the classifier of metastatic efficiency. These images unveiled pseudopodial extensions and increased light scattering as functional hallmarks of metastatic cells. They validated this interpretation by analyzing experimental image time-lapse sequences in which melanoma cells spontaneously transitioned between states indicative of low and high metastatic efficiency. Together, this data is an example of how the application of Artificial Intelligence supports the identification of processes that are essential for the execution of complex integrated cell functions but are too subtle to be identified by a human expert. Dr. Zaritsky also implement this methodology on human embryo cells images to identify features relevant for success of IVF procedure.

Application

Method that can be used to analysis the stage of melanoma and predict the chances to develop highly metastatic melanoma. Moreover, this tool also relevant for selection of human embryo in IVF that have high chances for success. The method describe here can be adapted for additional usages were functional hallmarks need to be diagnosis from label-free cell images, where the features are not known and obvious.

Advantages

- Platform that can be used for different applications
- Identify new features relevant for functionality
- Predication system
- Label-free cell images

Patent

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