UNIVERSITY OF TARTU
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Applications of Deep Neural Networks for Cell Phenotyping in Co-cultures

Master's Thesis (30 ECTS)

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Abstract: Co-culturing is a widespread method of growing multiple cell lines together to produce an environment that is close to natural conditions. Cells in co-cultures interact with each other which allows them to sustain longer than lonely. It is crucial e.g. in pharmacology to properly measure hepatotoxicity of certain drugs. However, having two or more kinds of cells on the same plate makes downstream image analysis more difficult. Hundreds of cells per image need to be classified automatically, which is a challenging problem. Training a proper classifier requires to spent hours working on annotation. Pipelines that are commonly used for this task employ cell segmentation with subsequent feature extraction or pixel-based classification. Recently, deep learning methods have proven to perform well for image recognition. In this work, we use convolutional neural networks to build a robust algorithm for cell phenotyping and counting in co-cultures. We show that zero-shot transfer learning allows avoiding monotonous annotation and maintaining the classification performance on a baseline level. With retraining, our model is able to outperform all the reference methods. These results are could be extremely important for both research and industry. Out-of-the-box classification models allow to fully automate co-culturing experiments. This would help to diminish scientific routine and speed up pharmacological research.

Keywords:
deep learning, neural networks, transfer learning, fluorescent microscopy, cell phenotyping, co-cultures

CERCS: T111 - Imaging, image processing; P176 - Artificial intelligence; B110 - Bioinformatics, medical informatics, biomathematics biometrics

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Võtmesõnad:
sügav õppimine, tehisnärvivõrgud, ülekandeõpe, fluorestsentsmikroskoopia, raku fenotüüpimine, rakukultuurid

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