TRACKING THE MORPHOLOGY OF CELLULAR SPHEROIDS PRESENT IN BRIGHTFIELD MICROIMAGES

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Tracking cellular spheroids (spheroidal cellular formations) when analyzing brightfield microscopy images, as well as processing their morphological parameters (diameter, area, volume), plays a crucial role in biological experiments. Yet, this task is notoriously time-consuming. Therefore, numerous attempts [1] have been made towards automation of the process.

The goal of this study was to create a machine learning model for automated tracking of spheroids and their morphology given sequential brightfield microimages. Structural schema of the algorithm is shown in Fig. 1:

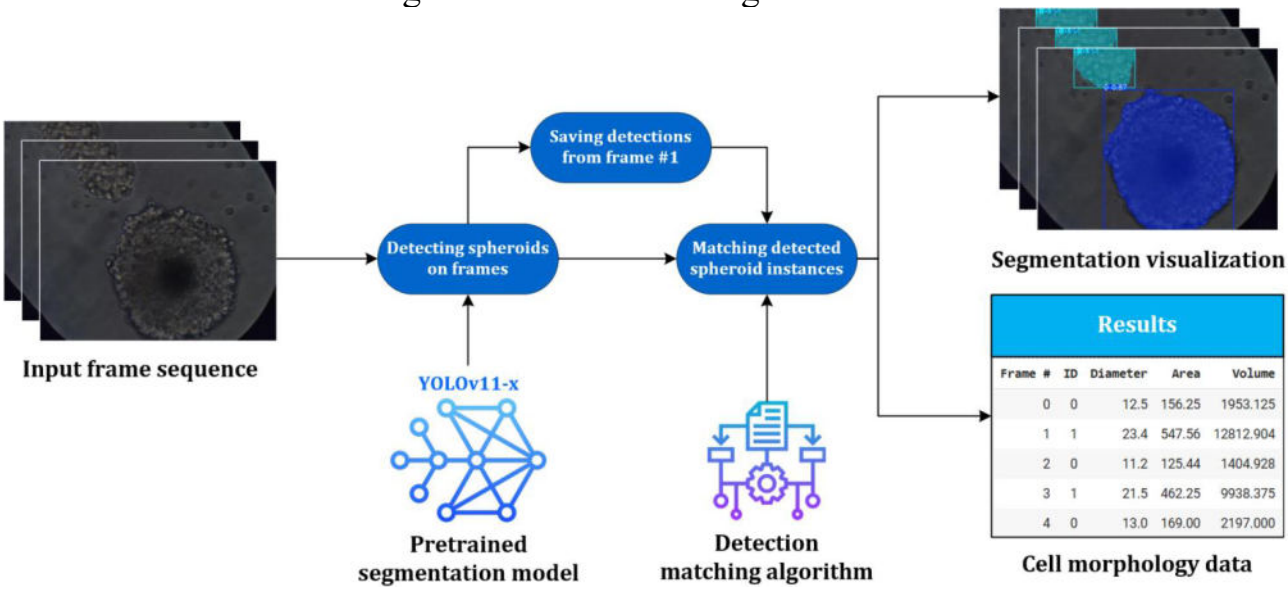

Fig. 1 – Spheroid morphology tracking pipeline schema

In this paper existing DL approaches were reviewed. Among them, tracking-by-detection seemed most reasonable, as it allowed to perform tracking by using a standard instance segmentation model supplemented by an additional strictly-defined algorithm, hence leading to fewer resources needed for both training and inference, while keeping the inference time low and the results' quality high enough [2].

The resulting tracker built upon a pre-trained YOLO11-x instance segmentation model and a custom tracking algorithm demonstrates State-Of-The-Art performance, achieving AP@50-95 of 87.1% on the test subset, while working well in resource-constrained environments. The model can be successfully used in biological research studies for the purpose of processing microimages of spheroids.

References (translated):

1. Prem Krishna Shrestha, Nicholas Kuang, Ji Yu, Efficient end-to-end learning for cell segmentation with machine generated weak annotations, 2023.

2. Kehao Du, Alexander Bobkov: An Overview of Object Detection and Tracking Algorithms, 2023.