W-NET for Tracking of Moving Subcellular Objects in Microscopy Images

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1. INTRODUCTION

Advanced microscopy has emerged as a powerful tool for biomedical research. The dynamic processes of subcellular organelles in living cells are closely related to the function of cells [1]. Thus, tracking various moving objects on subcellular scale and evaluating their dynamics quantitatively could be significant for the understating of cell function. As deep learning develops, it has been widely used in image processing and has achieved many inspiring results in biomedical applications [2]. In our research, we proposed a deep learning-based subcellular object tracker, which was shown to achieve a relatively high accuracy on microscopic datasets.

2. METHODS

The architecture of the proposed network, W-Net, is shown in Figure 1. The W-Net consists of two U-Nets [3], the first of which is for object localization while the second one is for centroid linkage.

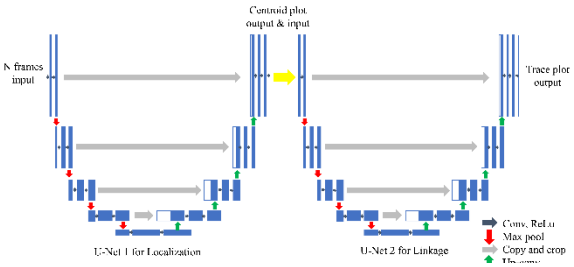

Figure 1: Overall framework of W-Net

The inputs to the first U-Net are series of fluorescence microscopic images, while the outputs are centroid series, which is used for the inputs to the second U-Net. And the final outputs are trajectories of moving objects.

3. RESULTS

We trained this novel network on our simulated datasets. We developed a model which can track subcellular objects and further classify them basing on their different modes of movements. For object localization task, the Jaccard Index (JSC) of our model is 99.0% on training datasets and 94.6% on test datasets. For tracking task, the JSC of our model is 99.2% on training datasets and 74.9% on test datasets.

References

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