SEGMENTATION: A DATA DRIVEN APPROACH THOUGH NEURAL NETWORK

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ABSTRACT

Image segmentation is a field that has known huge breakthroughs this last decade especially with applications to autonomous cars. We propose to adapt a recent method Mask R-CNN[1] to segment images of biological cells. The images used in this work are provided by a fluorescence microscope which brings artifacts and non-uniform brightness. Classical segmentation methods fail to segment the cells satisfactorily; to overcome this problem we make use of a state of the art deep learning method. This method is trained on a very small dataset and provides both segmentation and confidence score. We then use the segmentation maps to produce segmentation and tracking on videos.

***Index Terms*—** Segmentation, tracking, neural-network.

1. MOTIVATION

The image segmentation problem is a widely studied problem. However, some particular datasets can lead the usual algorithms to fail. We display an example of this in Figure1a. One difficulty is that the intensity of the cells vary in the same frame. Also, the intensity of the cells can be of the same order of magnitude as the background intensity. In addition, the images are degraded by noise.

2. LEARNING METHOD

We develop a learning based approach to overcome the failure of classical algorithms. We believe that this makes the method possibly useful in many other applications where a learning set is available.

We use the recent neural network Mask R-CNN, we refer the interested reader to the original paper [1] for its complete description. We display in Figure 1c the segmentation result given by Mask R-CNN, note that a confidence score is shown for each mask. In practice, we only keep masks with confidence scores above a threshold calibrated depending on the desired result.

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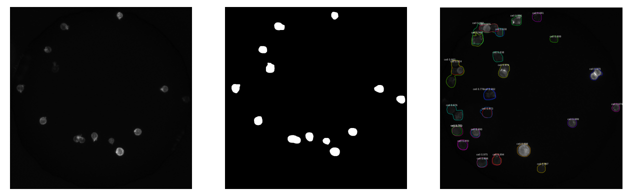

(a) True image. (b) Segmentation. (c) Mask R-CNN.

This network is easily deployable and fast to train due to the use of transfer learning for the backbone encoder. Backbone encoders such as Resnet are available, several depths are proposed : 50, 100 or more layers [2]. This encoder allows the extraction of a compact feature set that encapsulates the specificity of the image, reducing the training complexity.

Numerical experiments tend to indicate that transfer learning copes with small datasets and yields better results than a U-Net trained from scratch. The learning dataset is rather small (approx 500), note that we use data-augmentation such as rotation, pixels flip, etc...

3. CONCLUSION

We show that Mask R-CNN can be used to segment various real life images with a limited number of ground-truth examples. This network helps us to highly accelerate the post-processing of microscope images. Depending on the interest of the community we may provide an easy to use code to reproduce similar results.

4. REFERENCES

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