Deep Learning for Cell Nuclei Detection in Biomedical Imaging

Computer Vision (CS6350)
TPA - 1

1 Problem Statement

Detailed measurement of cell information from digital images has the potential to greatly advance biomedicine in various disciplines such as patient diagnostics or drug screening. But, the complexity of cell conformations poses a great challenge preventing effective determination of cell boundaries and centers. Also, manual assessment is labor intensive and prone to interobserver variations making the process horrendously complicated. Thus computer-aided diagnosis systems (like for cell detection and segmentation) are proven to significantly improve the objectivity and reproducibility. Although a plethora of such systems exists, accurate detection is challenging because of cell-to- cell variability, cell shape irregularities, image noise and contrast which requires problem-specific tailoring of algorithms. The purpose of this project is to overcome these issues and come up with an efficient deep learning based algorithm that allows us to rapidly obtain accurate cell centers from mouse brains in an automated format.

2 Input

- Images consisting green fluorescent protein (GFP) tagged cells.

3 Output

- Location of the cell nuceli(centres) in the image. This is to be shown for 10 tiles that will be provided.

4 Datasets

- GFP Dataset (will be provided)

5 References

- Shaoqing Ren, Kaiming He, Ross Girshick, Jian Sun "Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks", NIPS 2015.
- Wei Liu, et al. "SSD: Single Shot MultiBox Detector", ECCV 2016.
- Tsung-Yi Lin, Priya Goyal, Ross Girshick, Kaiming He, Piotr Dollr "Focal Loss for Dense Object Detection", ICCV 2017.
- Weidi Xie, J. Alison Noble, Andrew Zisserman "Microscopy cell counting and detection with fully convolutional regression networks", Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization, 2018.
- Songtao Liu, Di Huang, Yunhong Wang "Receptive Field Block Net for Accurate and Fast Object Detection", ECCV 2018.
- YuanPu Xie, Fuyong Xing, Xiaoshuang Shi, Xiangfei Kong, Hai Su, Lin Yang "Efficient and robust cell detection: A structured regression approach", Medical Image Analysis, 2018.
- Olaf Ronneberger, Philipp Fischer, Thomas Brox "U-Net: Convolutional Networks for Biomedical Image Segmentation", MICCAI 2015.