Deep Learning-enabled Computational Microscopy

Aydogan Ozcan[1]

[1] UCLA, Los Angeles, USA

ozcan@ucla.edu

Abstract:

Deep learning is a class of machine learning techniques that uses multi-layered artificial neural networks for automated analysis of signals or data. The name comes from the general structure of deep neural networks, which consist of several layers of artificial neurons, each performing a nonlinear operation, stacked over each other. Beyond its main stream applications such as the recognition and labeling of specific features in images, deep learning holds numerous opportunities for revolutionizing image formation, reconstruction and sensing fields. In this presentation, I will provide an overview of some of our recent work on the use of deep neural networks in advancing computational microscopy and sensing systems, also covering their biomedical applications.
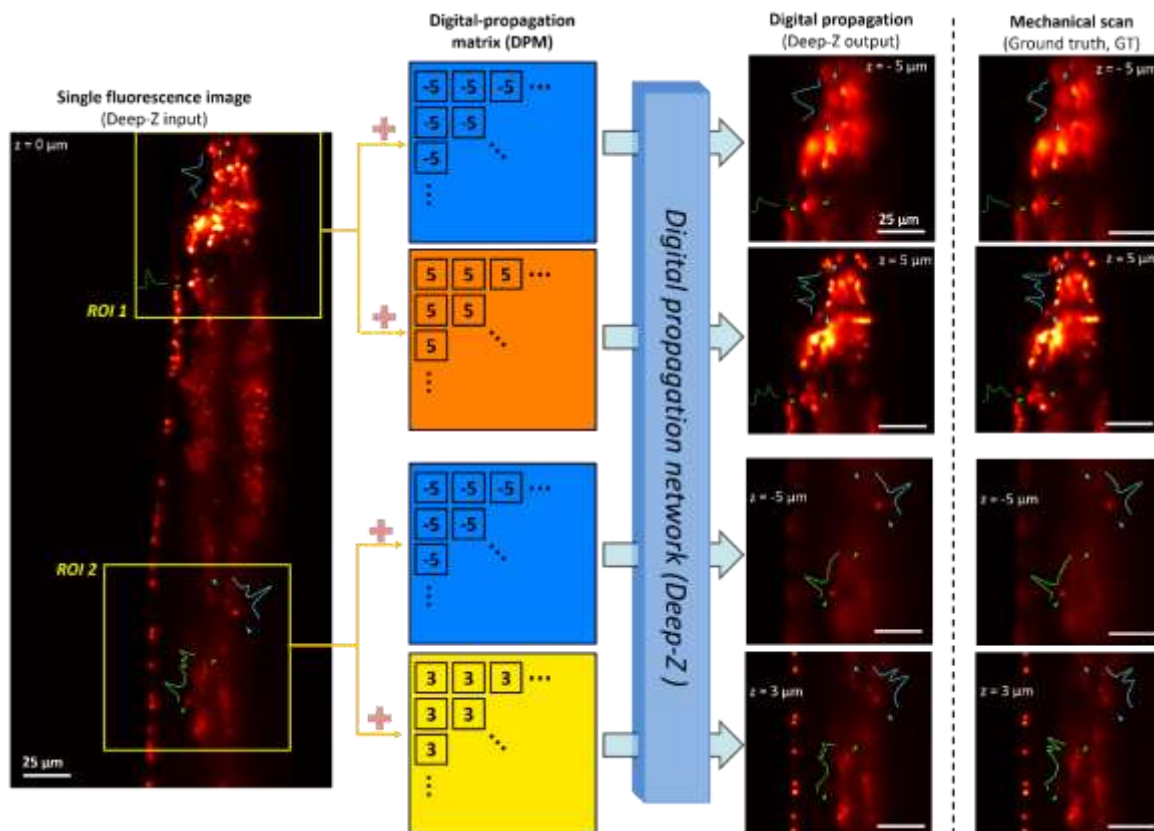
Figure

Figure 1. Virtual refocusing of fluorescence images of a *C. elegans* nematode. A single fluorescence image (input) is passed through a trained Deep-Z network, to virtually create refocused images at different planes. The digitally propagated images provide a very good match to the corresponding ground-truth images (mechanically scanned), acquired using a scanning fluorescence microscope. Ref: "*Three-dimensional virtual refocusing of fluorescence microscopy images using deep learning*" *Nature Methods* (2019)