Object Detection Networks and Augmented Reality for Automation of Fluorescence Microscopy Acquisition and Analysis.

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In this work we demonstrate the application of object detection networks for the classification and localization of cells in fluorescence microscopy. These networks are then presented in their capacity to guide and optimize an automated 3-D microscopy acquisition pipeline. Furthermore, we show how these networks can also be used as the basis for an innovative microscopy Augmented Reality system to provide feedback to the user in real-time. Object detection networks are well-known high performance algorithms famously applied to the task of identifying and localizing objects in photography images, here we show their application and efficiency for localizing cells in fluorescence microscopy. In the field of photography, object detection algorithms are typically trained on many thousands of images, which can be prohibitive within the biological sciences due to the cost of imaging and annotating large data. We benchmark two leading object detection algorithms across multiple challenging 2-D microscopy datasets and show that with some careful considerations that it is possible to achieve very high performance with datasets with as few as 25 images present. Through this work, it is possible for relatively non-skilled users to automate detection of a variety of cell classes using microscopy and opens up new avenues for automation and visualization of conventionally manual microscopy acquisition pipelines.