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A Framework for Creating Realistic Synthetic Fluorescence Microscopy Image Sequences

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Abstract

Fluorescence microscopy imaging is an important tool in modern biological research, allowing insights into the processes of biological systems. Automated image analysis algorithms help in extracting information from these images. Validation of the automated algorithms can be done with ground truth data based on manual annotations, or using synthetic data with known ground truth. Synthetic data avoids the need to annotate manually large datasets but may lack important characteristics of the real data. In this paper, we present a framework for the generation of realistic synthetic fluorescence microscopy image sequences of cells, based on the simulation of spots with realistic motion models, noise models, and with the use of real background from microscopy images. Our framework aims to close the gap between real and synthetic image sequences. To study the effect of real backgrounds, we compared three spot detection methods using our synthetic image sequences. The results show that the real background influences spot detection, reducing the effectiveness of the spot detection algorithms, indicating the value of synthetic images with a realistic background in system validation.