AUTOMATED IMAGE PROCESSING FOR THE ANALYSIS OF DNA REPAIR DYNAMICS

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1. INTRODUCTION
The efficient repair of cellular DNA is essential for the maintenance and inheritance of genomic information. In order to cope with the high frequency of spontaneous and induced DNA damage, a multitude of repair mechanisms have evolved. These are enabled by a wide range of protein factors specifically recognizing different types of lesions and finally restoring the normal DNA sequence. This work focuses on the repair factor XPC (xeroderma pigmentosum complementation group C), which identifies bulky DNA lesions and initiates their removal via the nucleotide excision repair pathway. The binding of XPC to damaged DNA can be visualized in living cells by following the accumulation of a fluorescent XPC fusion at lesions induced by laser microirradiation in a fluorescence microscope.

2. SEGMENTATION AND ROI DETECTION
An automated image processing pipeline is proposed, which allows to identify and quantify the accumulation reaction without any user interaction. The image processing pipeline comprises a preprocessing stage where the image stack data is filtered and the nucleus of interest is segmented. Afterwards, the images are registered to each other in order to account for movements of the cell, and then a bounding box enclosing the XPC-specific signal is automatically determined. Finally, the time-dependent relocation of XPC is evaluated by analyzing the intensity change within this box.

3. RESULTS
Comparison of the automated processing results with the manual evaluation as done in [1] yields qualitatively similar results. However, the automated analysis provides more accurate, reproducible data with smaller standard errors. The proposed image processing pipeline allows for an efficient analysis of large amounts of experimental data with no user interaction required.

REFERENCES