IOP Publishing Measurement Science and Technology

Meas. Sci. Technol. 36 (2025) 015418 (13pp) https://doi.org/10.1088/1361-6501/ad8b61

Fluorescence microscopic image enhancement method based on multi-saliency guided filtering fusion

Qiu Hu[1,2,3,*], **Haiwei Zeng**[1], **Yanzi Miao**[2], **Kehui Wang**[3], **Shuangle Wu**[1], **Wenhui Li**[3] **and Zhiwang Zhang**[1]

[1] School of Information Science and Engineering, NingboTech University, Ningbo, People's Republic of China

[2] School of Information and Control Engineering, China University of Mining and Technology, Xuzhou, People's Republic of China

[3] Konfoong Bioinformation Tech Co., Ltd, Ningbo, People's Republic of China

E-mail: hu_qiu@nbt.edu.cn

Received 27 July 2024, revised 13 October 2024
Accepted for publication 25 October 2024
Published 5 November 2024

Abstract

Aiming at addressing the issues of colour deviation and clarity reduction in digital pathological imaging systems caused by complex environmental interferences such as uneven slice thickness, sample jitter, and background noise, this paper proposes a multi-saliency-guided filtering fusion enhancement method that combines energy saliency and Gaussian saliency. Firstly, a series of Gamma correction and spatial linear saturation adjustments are applied to enhance the contrast and colour saturation of blurred images, resulting in a sequence of pseudo-exposure images with improved contrast and saturation. Then, the pseudo-exposure images are decomposed into base and detail layers, and the fusion rules of energy saliency and Gaussian saliency-guided filtering are applied to each layer separately. Finally, clear microscopic images are obtained through two-scale reconstruction. This method overcomes the limitations of conventional deblurring algorithms that rely on prior estimation of scene depth and complex depth mapping processes. Experimental results on a dataset of cytological bright-field microscopic imaging samples show that the clarity evaluation metrics, including peak signal-to-noise ratio, root mean square error, and structural similarity index, have significantly improved, indicating that the proposed method can effectively improve the colour fidelity of the samples while eliminating noise interference and enhancing the clarity of cellular texture structures.

Keywords: digital pathological imaging, image enhancement, image fusion, guided filtering, saliency detection

1. Introduction

The digital pathology is an emerging diagnostic method in the field of tumour detection that combines whole slide imaging with pathological image analysis algorithms. It is characterized by high resolution, precision, and efficiency, enabling the accurate extraction and analysis of morphological and structural information from pathological samples. This leads to more accurate and objective diagnostic results, avoiding the influence of subjective factors in traditional pathological diagnoses, and is thus regarded as the gold standard in pathological diagnosis within the industry. However, the large amount of redundant information in scanning images can interfere with the pathological diagnosis process. This necessitates the use of pathological image analysis algorithms to mine

* Author to whom any correspondence should be addressed.