

EFFECT OF GREY LEVEL TRANSFORMATION TECHNIQUES ON KEYPOINT BASED DIFFERENTIATION OF INTERMEDIATE INDIRECT IMMUNOFLUORESCENCE IMAGES

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ABSTRACT

In this study, the effect of grey level transformation techniques on the differentiation of intermediate intensity Indirect Immunofluorescence (IIF) images is investigated. IIF imaging is a standard laboratory test used for the screening of autoimmune diseases. Manual interpretation of the intermediate intensity IIF images is complex in nature due to the poor cell structure visibility. To enhance the texture information and cell nuclei structure of the intermediate intensity images, effective pre-processing is required. For this, intermediate intensity images of homogenous and speckled patterns from publicly available dataset are considered. The images are pre-processed using three different grey level transformation techniques namely contrast stretching, contrast limited adaptive histogram equalization and local contrast enhancement. Further, Speeded-up Robust Feature (SURF) keypoint features are extracted for original and contrast enhanced images. The results indicate that the pre-processing using contrast stretching shows significant increase in the detection of SURF keypoints. It has been observed that the average number of keypoints has increased from 12.54 ± 35.84 (Mean ± SD) to 1002.81 ± 696.71 due to the contrast stretching process. As automated analysis of autoimmune diseases is highly significant, this study seems to be clinically relevant.

Keywords: Indirect Immunofluorescence, Autoimmune disease, Grey level transformation, Speeded-Up Robust Feature

INTRODUCTION

Autoimmune diseases are caused due to immune system dysfunction that are characterized by chronic inflammation and damage of the target tissues. Indirect Immunofluorescence (IIF) Imaging is the benchmark laboratory test for the diagnosis of autoimmune diseases [1, 2]. In IIF imaging, Antinuclear antibody (ANA) detected in the patient serum acts as biomarker for the immune system dysfunction [3, 4]. Generally, IIF method is preferred for ANA screening since it highly sensitive and has wide range of antigen expression [5]. The manual interpretation of IIF images is challenging since it is subjective and prone to intra and inter laboratory variabilities [2, 4]. Therefore, there is a necessity for computer aided diagnosis of IIF images in clinical environment to overcome the shortcomings in the visual observation [1, 3].

In IIF imaging, the most observed ANA staining patterns are homogenous, speckled, nucleolar and centromere [5, 6]. The homogenous pattern is indicative of diseases such as systemic lupus erythematosus, rheumatoid arthritis and is observed as uniform diffuse fluorescence in the cell nuclei [7]. The speckled pattern has fine or coarse granular staining with nuclear dots. This pattern is associated with diseases such as scleroderma, polymyositis and neonatal lupus syndrome [7]. Further, the speckled pattern can be categorized into fine, dense fine and coarse speckled patterns. Both homogenous and speckled IIF images are often misinterpreted since due to almost similar shape property [8]. Since the clinical relevance of each pattern is unique, differentiation of these two closely resembled staining patterns is necessary [9].

The IIF image interpretation has high inter and intra-class variations due to the poor cell structural visibility of the intermediate intensity images [10]. Pre-processing of the IIF images is essential to enhance the cell nucleus contrast from the background [1]. Grey level or intensity transformation is