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Automated Framework for Accurate Segmentation of Pressure Ulcer Images

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Abstract

Ulcer tissue segmentation is of immense importance in helping medical personnel to assess wounds. This paper introduces a new computational framework employing state-of-the-art image processing techniques to segment pressure ulcer tissue structures from color images. The framework integrates a visual appearance model of an observed input image with prior color information from an available database of previously stored color RGB images. The following four processing steps are performed. First, to minimize the execution time and enhance the segmentation accuracy, a region-of-interest (ROI) of the whole ulcer area is automatically identified based on contrast changes. This step exploits synthetic frequencies of pixelwise intensities, which are calculated by using an electric field energy model to describe relations between the pixelwise intensities. Secondly, visual appearance of the observed image is modeled by a linear combination of discrete Gaussians (LCDG) model in order to estimate marginal probability distributions of three main tissue classes for the grayscale ROI image. Next, the pixel-wise probabilities of these classes for the color ROI image are calculated using the available prior information about the RGB colors on manually segmented database images. Initial labeling is obtained based on both the observed and prior probabilities of pixelwise colors. Finally, to preserve continuity, the labels are refined and normalized using the generalized Gauss-Markov random field (GGMRF) model. Experimental validation on 24 clinical images of pressure ulcers, provided by the Centre IGURCO, showed the high segmentation accuracy of 90.4%.

Keywords: Pressure ulcer; LCDG; GGMRF; segmentation; RGB.

1. Introduction

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