

Breast lesion Segmentation in Ultra-Sound images based on super-pixels and high-level descriptors

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ABSTRACT

This document shows the desired format and appearance of a manuscript prepared for the Proceedings of the SPIE. It contains general formatting instructions and hints about how to use LaTeX. The LaTeX source file that produced this document, `article.tex` (Version 3.3), provides a template, used in conjunction with `spie.cls` (Version 3.3).

Keywords: Breast Ultra-Sound, Machine-Learning based Segmentation

1. INTRODUCTION

Breast cancer is the second most common cancer (1.4 million cases per year, 10.9% of diagnosed cancers) after lung cancer, followed by colorectal, stomach, prostate and liver cancers.¹ In terms of mortality, breast cancer is the fifth most common cause of cancer death. However, it place as the leading cause of cancer death among females both in western countries and in economically developing countries.²

Medical imaging plays an important role in breast cancer mortality reduction, contributing to its early detection through screening, diagnosis, image-guided biopsy, treatment follow-up and suchlike procedures.³ Although Digital Mammography (DM) remains the reference imaging modality, US imaging has proven to be a successful adjunct image modality for breast cancer screening,^{3,4} specially as a consequence of the discriminative capabilities that US offers for differentiating between solid lesions that are benign or malignant⁵ so that the amount of unnecessary biopsies, which is estimated to be between 65 ~ 85% of the prescribed biopsies,⁶ can be reduced⁷ in replacing them by short-term US screening follow-up.⁸

Figure ... shows ... what doctors look for.

Analysing figure ... it can be observed that most of the markers depend on the lesion delineation. Therefore in order to develop releable Computer Aided Diagnose (CAD) systems accurate segmentations to properly delineate the lesions are needed. This article presents a segmentation technique based on classifying superpixels based on their appearance.

2. SEGMENTATION METHODOLOGY DESCRIPTION

Optimization methodologies offer a standardized manner to approach segmentation by minimizing an application-driven cost function.⁹ The segmentation strategy here adopted is formulated as a *metric labelling* problem. The image is conceived as a discrete set of elements \mathcal{S} that need to be labelled using a label l from a labelling set \mathcal{L} (i.e. $l \in \{\text{lesion, lesion}\}$ or $l \in \{\text{lungs, fat, parenchyma, .. ., lesion}\}$). Let \mathcal{W} be all the possible labelling configurations of the set \mathcal{S} given \mathcal{L} , and let $U(\cdot)$ be a cost function encoding how good is a labelling configuration $\omega \in \mathcal{W}$ based on the appearance of the elements in \mathcal{S} , their relation and some designing constrains. Then the desired segmentation $\hat{\omega}$, corresponds to the labelling configuration minimizing this cost function, $\hat{\omega} = \arg \min_{\omega} U(\omega)$.

For further interpretation, ?? shows the cost details; fig. 1 illustrates a generic version of the segmentation strategy here proposed; and, ?? offers an interpretation of the terms found in ?? and fig. 1 applied to breast lesion segmentation in US images.

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$$U(\omega) = \sum_{s \in S} D_s(\omega_s) + \sum_s \sum_{r \in \mathcal{N}_s} V_{s,r}(\omega_s, \omega_r) \quad (1)$$

The $U(\omega)$, as defined in ??, is the combination of two independent cost functions that are simultaneously minimized as a whole. The former term, $D_s(\omega_s)$, is referred to as the *data* term, while the latter, $\sum_{r \in \mathcal{N}_s} V_{s,r}(\omega_s, \omega_r)$, is indistinctly referred to as the *pairwise* or *smoothing* term. The data term is the cost of assigning a particular label l (also denoted ω_s) to the site s based on the image data of s , whereas the pairwise or smoothing term represents the cost of the assignment ω_s taking into account the labels of its neighbour sites, $\omega_r, r \in \mathcal{N}_s$.

As illustrates fig. 1, in order to produce a segmentation, the image is *mapped* or represented using *super-pixels*.
the elements here used

The image

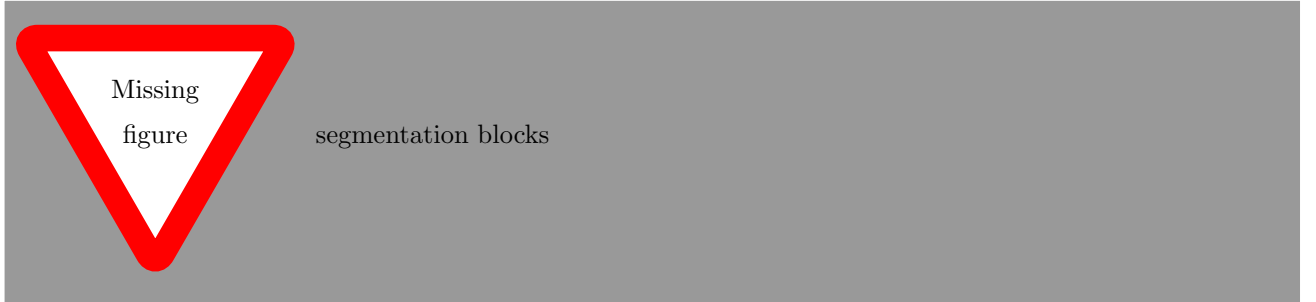


Figure 1. Conceptual block representation of the segmentation methodology

3. FEATURE DESCRIPTION

Features description

ACKNOWLEDGMENTS

This unnumbered section is used to identify those who have aided the authors in understanding or accomplishing the work presented and to acknowledge sources of funding.

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