On breast lesion segmentation in Ultra-Sound images and its assessment: A survey

Joan Massich[1,☯],Guillaume Lemaître[1,2,☯],Mojdeh Rastrgoo[1,2,☯],Joan Martí[2],Fabirce Mérieaudeau[1,‡],

1 Le2i-UMR CNRS 6306, Université de Bourgogne, 71200 Le Creusot, France
2 ViCOROB, Universitat de Girona, 17071 Girona, Spain

☯These authors contributed equally to this work.
‡These authors also contributed equally to this work.
*** joan.massich@u-bourgogne.fr**

Abstract

Introduction

sec:intro

- Narrow to the need of accurate delineations
- What is reviewed and what is not
- Article Objectives
- similar works
- paper structure

sec:intro:to_delinations

the need of accurate delineations

1. breast cancer kills
2. screening is needed for early detection
3. Health from images is like any other visual inspection
   - Radiologic diagnisis error rates are similar to any other human visual inspection manning2005perception [1]
   - Utilization of computers to aid the Radiologists during the diagnosis process giger2008anniversary [2]
4. Advantage of Ultra-Sound (US)
5. Breast Imaging-Reporting and Data System (BI-RADS)
6. need of accurate delineations

Breast cancer is the leading cause of cancer deaths among females worldwide cancerStatisti [3]. Nevertheless, death by breast cancer are highly reduced when early treated. Thus, to run a chance of surviving breast cancer, it is uttermost important the early detection of malignant tumors. This has motivated the establishment of Breast Screening PolicyBreast Screening Policies (BSPs) to facilitate this breast cancer detection at an early stage. Despite X-ray Digital Mammography (DM) is considered the gold standard technique for BSP, other screening techniques like US and Magnetic Resonance Imaging are being investigated to overcome DM limitations due to tissue superposition which can either mimic or obscure malignant pathology, and avoid X-ray radiation all together.

Medical imaging contributes to its early detection through screening programs, non-invasive diagnosis, follow-up, and similar procedures. Despite Breast Ultra-Sound (BUS) imaging not being the imaging modality of reference for breast cancer screening smith2003american [4], US imaging has more discriminative power when compared with other image modalities to visually differentiate benign from malignant solid lesions Stavros:1995p12392 [5]. In this manner, US screening is estimated to be able to reduce between $65 \sim 85\%$ of unnecessary biopsies, in favour of a less traumatic short-term screening follow-up using BUS images. As the standard for assessing these BUS images, the American College of Radiology (ACR) proposes the BI-RADS lexicon for BUS images biradsus [6]. This US BI-RADS lexicon is a set of standard markers that characterizes the lesions encoding the visual cues found in BUS images and facilitates their analysis. Further details regarding the US BI-RADS lexicon descriptors proposed by the ACR, can be found in Sect. sec:methodApp **??**, where visual cues of BUS images and breast structures are discussed to define feature descriptors.

The incorporation of US in screening policies and the emergence of clinical standards to assess image like the US BI-RADS lexicon, encourage the development of Computer Aided Diagnosis (CAD) systems using US to be applied to breast cancer diagnosis. However, this clinical assessment using lexicon is not directly applicable to CAD systems. Shortcomings like the location and explicit delineation of the lesions need to

be addressed, since those tasks are intrinsically carried out by the radiologists during their visual assessment of the images to infer the lexicon representation of the lesions.

sec:intro:what_is_reviewed

What is reviewed We made a systematic survey to facilitate replication or reviewing of our thoughts. Based on an initial query, an initial set of works published during the last five years are pulled out from a journal selection. Natural Language Tool Kit (NLTK) [7] bird2009natural is used to analyse the main concerns of these works and determine the main lines to drive this study. Highly influential works are used to conduct this discussion.

sec:intro:article_objective

Article objective

The objective of this article is

- to provide an exhaustive list of segmentation methodologies that have been developed for delineating breast lesions in US images.
- to collect a set of terms that facilitate placing each work with respect of the rest of the State-of-the-Art.
- to provide an overview of how each methodology has been assessed.
- to clarify assessment assumptions that influence a fair results comparison.

A secondary objective of the authors, but equally essential to us, is

- to ensure comprehensive coverage of the available segmentation methodologies.
- fair treatment.
- reusability of the efforts put in this article.

sec:intro:similar_works

similar works

sec:intro:paper_structure

Paper structure

1 materials and methods (Segmentation method analysis)

project website in github

Thus, the set of queries that generate the pool of methodologies present in this work are available at the *us-breast-lesion-delineation-survey* open repository as scripts. These queries screen all the publications included by targeted journals during the last 5 years for articles matching any of the search terms in order to build a bibliographic dataset. This dataset is complemented collecting all the articles that expand the citations tree, both forward and backwards, up to 2 levels. More details about this process can be found at the website of the project. Automatic criteria are used for rough pruning of the dataset while the final pruning has been carried out manually. Details of both are provided at the website.

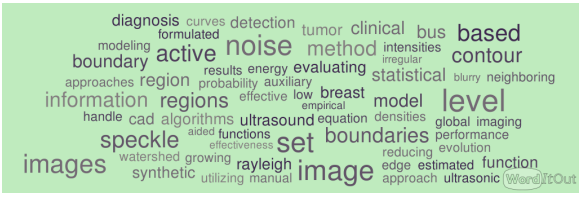

Figure 1. ~~Word cloud representing the key-concepts generated from the bibliographic corpus.~~[sik]("make better caption")

fig:wcloud

sec:intro:analysis_of_the_methods

Analysis of the methods Apart from the gathering of the papers to review, the analysis has been done in the following manner: [sik]

- the analysis is carried out in both bottom-up and top-down fashion[sik]
- using a generic corpora, key concepts from the selected articles are extracted using Rake algorithm.[sik]
- the key concepts are studied and they mainly cluster in four categories: (1) medical-breast related, (2) segmentation strategy, (3) evaluation, (4) other.[sik]
- highly cited articles in such topics are used to refine the initial corpora and update the key concepts of each paper for the bottom-up description.[sik]
- for the top-down strategy reference bibliography is used to drive the discussion of the articles key-concepts[sik]

Table 1. ~~Query.~~[sik]("make better caption")

token	keyword
organ:	breast
task:	segmentation, delineation, contouring
modality:	Ultrasound, Ultra-Sound, Ultrasonic,
	US image, Sonography, Sonograms
target publications:	

A combination of these keywords is used for each search.[sik]("table notes")

table1

Todo list

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