

Breast Ultrasound Image Segmentation: an optimization approach based on super-pixels and high-level descriptors

Joan Massich
joan.massich@u-bourgogne.fr

Université de Bourgogne

Quality Control by Artificial Vision
4th June 2015



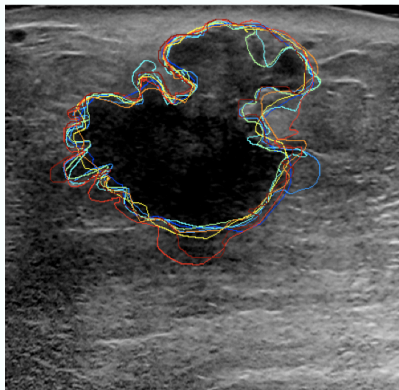
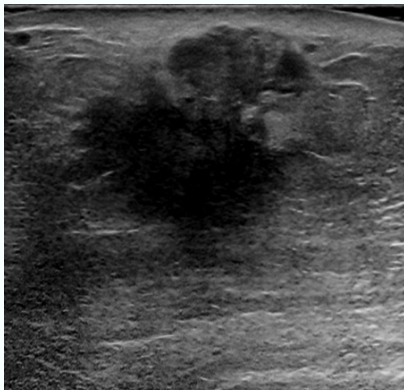
Features Training CostFunction
Data 12CVB ComputerAidedDiagnosisCAD Lesion
InterIntraObserver ModelLearning SearchSpace Segmentation
OpenResearch Modeling SuperPixel AreaOverlap Imaging
Optimization Stochastic
Minimization BIRADS Cancer GraphCuts
Ultrasound Breast MachineLearning

A word cloud on a dark blue background featuring various terms related to medical imaging and machine learning. The words are arranged in a dense, overlapping manner. The most prominent words, shown in a larger font size, include 'Optimization', 'Segmentation', 'Lesion', 'Breast', 'CostFunction', 'Data', '2CVB', 'Imaging', 'Stochastic', 'Ultrasound', 'BIRADs', 'MachineLearning', 'Minimization', 'Features', 'Training', 'OpenResearch', 'Modeling', 'SuperPixel', 'AreaOverlap', 'GraphCuts', 'Cancer', 'MachineLearning', 'InterIntraObserver', 'SearchSpace', 'ComputerAidedDiagnosisCAD', 'ModelLearning', and 'MachineLearning'. The words 'Segmentation' and 'Lesion' are highlighted in a bright orange color, while all other words are in a dark blue color matching the background.

Features Training CostFunction
Data 2CVB ComputerAidedDiagnosisCAD
InterIntraObserver Lesion
ModelLearning SearchSpace
OpenResearch Segmentation
Modeling SuperPixel AreaOverlap Imaging
Minimization BIRADs Stochastic
Ultrasound Breast GraphCuts
MachineLearning



Breast Lesion Segmentation in US images



A word cloud of terms related to medical image analysis and optimization. The words are arranged in a dense, overlapping manner, with 'Optimization' being the largest and most central word. Other prominent words include 'Segmentation', 'Breast', 'CostFunction', 'Lesion', 'Data', 'Training', 'Features', 'BIRADs', 'Ultrasound', 'MachineLearning', 'Imaging', 'Stochastic', 'GraphCuts', 'AreaOverlap', 'SuperPixel', 'Modeling', 'OpenResearch', 'InterIntraObserver', 'ModelLearning', 'SearchSpace', 'ComputerAidedDiagnosisCAD', 'Minimization', and 'Cancer'. The words are in various shades of orange and brown, with some in a lighter, semi-transparent font.

Optimization

Segmentation

Breast

CostFunction

Lesion

Data

Training

Features

BIRADs

Ultrasound

MachineLearning

Imaging

Stochastic

GraphCuts

AreaOverlap

SuperPixel

Modeling

OpenResearch

InterIntraObserver

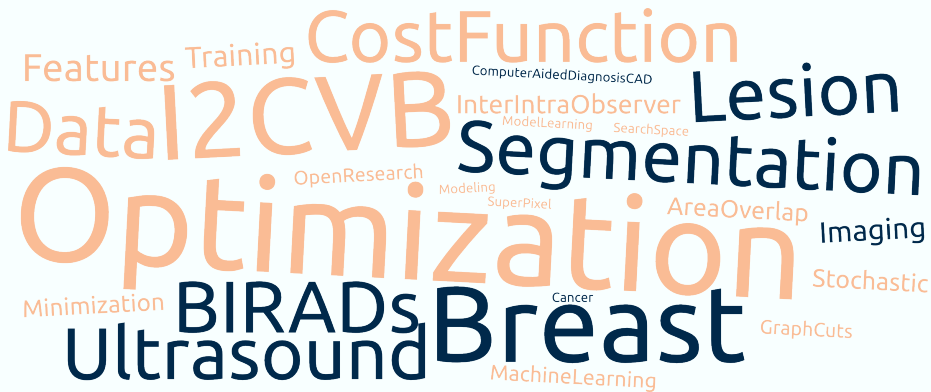
ModelLearning

SearchSpace

ComputerAidedDiagnosisCAD

Minimization

Cancer



Optimization

Segmentation

Breast

Lesion

CostFunction

Data

2CVB

Imaging

Ultrasound

BIRADs

MachineLearning

Stochastic

AreaOverlap

OpenResearch

Modeling

SuperPixel

Cancer

Minimization

Features

Training

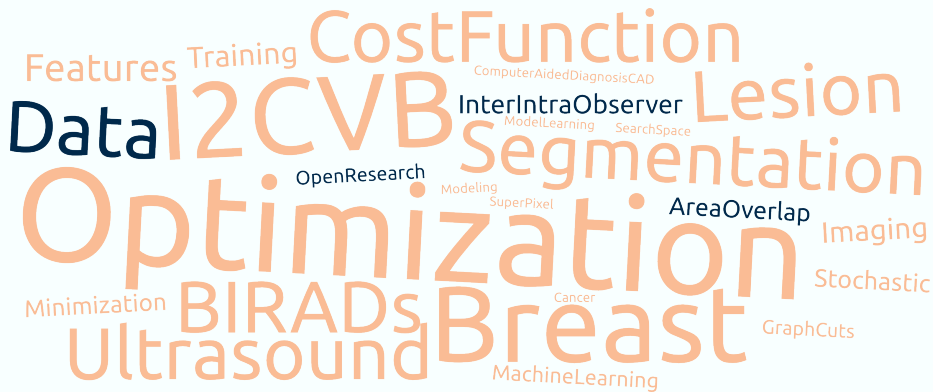
ComputerAidedDiagnosisCAD

InterIntraObserver

ModelLearning

SearchSpace

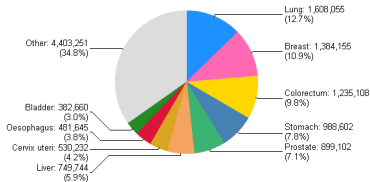
GraphCuts



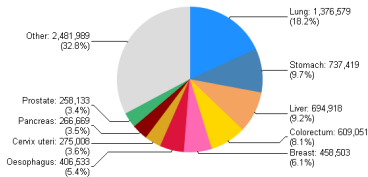


Motivations

Statistics



(a) # of cancer cases



(b) # of cancer deaths

Implications

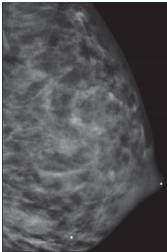
- ▶ 1.4 million cases per year
- ▶ 10.9% of diagnosed cancers
- ▶ 5th cause of cancer death (1th females)



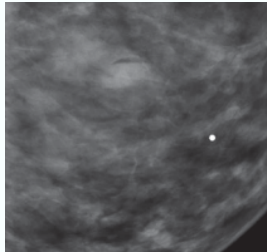
Breast Imaging

Ultra-Sound(US) imaging, the most common adjunct modality

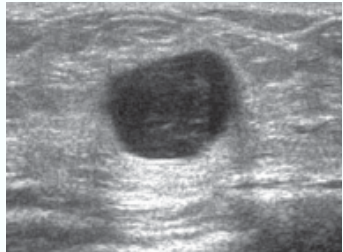
- ▶ Ability to discern solid lesions typologies
- ▶ Lesions shielded by dense breast in Digital Mammography(DM) are distinguishable in US



(c) DM



(d) DM, Region of Interest (ROI)



(e) Breast Ultra-Sound(BUS), ROI



Breast structures under US screening

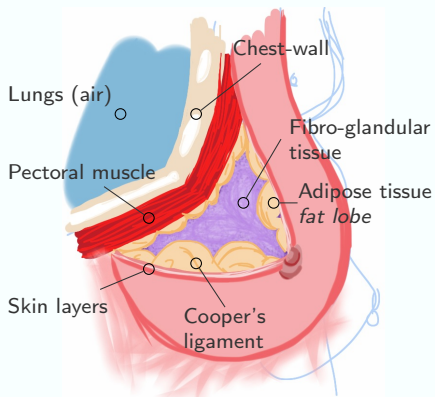


Figure: Breast structure elements.

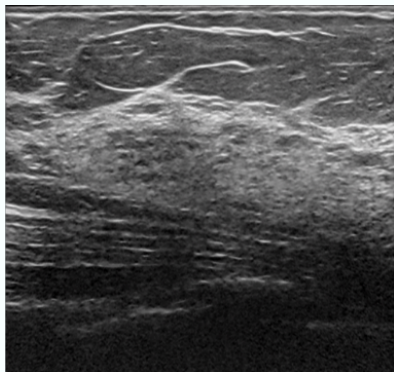


Figure: Breast US image example.



State of health from image visual Inspection

Radiologic diagnosis error rates are similar to any other human visual inspection

- ▶ Quality of the images.
- ▶ Ability to interpret the physical properties of the images.

1. Double readings.
2. Computer Aided Diagnosis(CAD).



BI-RADS Lexicon

A standardized toolkit tested for diagnosis

- ▶ BKGD Echotexture : adipose, fibro-glandular, heterogeneous

- ▶ Mass shape :



- ▶ Mass orientation :



- ▶ Mass margin :



- ▶ Lesion boundary :






- ▶ Echo pattern :



- ▶ Posterior acoustic pattern :



⁰  benign,  malignant and  undetermined



Take away
Accurate delineations to develop CAD systems for BUS

