Helder Cesar Rodrigues de Oliveira

BSc. Computer Science / MSc. Electrical Engineering / PhD Candidate

Education

2016–Present **PhD**, *University of São Paulo*, São Carlos, Brazil.
Electrical Engineering

2017-2017 **PhD-Sandwich**, *Università degli Studi di Roma "Tor Vergata"*, Rome, Italy.
Electronic Engineering

2014–2015 **Master**, *University of São Paulo*, São Carlos, Brazil.
Electrical Engineering

2009–2013 **Bachelor**, *University of State of São Paulo*, Presidente Prudente, Brazil.
Computer Science

PhD thesis (Proposed)

Title *Detection of Architectural Distortion in Digital Breast Tomosynthesis Images*

Supervisor Marcelo Andrade da Costa Vieira

Description This work aims to propose a computational system for the detection of architectural distortion of breast in digital breast tomosynthesis images. The breast cancer is the main disease that affects women worldwide and the treatment is more effective if it is diagnosed in early stage. Since 2011, in the screening programs of developed countries a new modality of exams have been used, the Digital Breast Tomosynthesis (DBT), which has several advantages compared to digital mammography. Regardless of the exam used, the radiologist looks for suspicious signs in the image, such as: nodules, microcalcifications and architectural distortion (AD). The latter may represents the earliest stage of a developing cancer and, may manifests up to two years before the formation of any other lesion. However, AD is difficult to detect because it changes the breast tissue subtly, with no mass formation or defined border. In general 50% of cases of AD are lost because the radiologist can not to identify it. The method proposed in this work has the novelty of detecting AD in DBT exams considering the entire breast volume. For this, it is presented a systematic pipeline beginning wuth the preprocessing of the image until the localization of the suspected region. Preliminary results show that the proposed approach has sensitivity of 90 % with only one false-positive per image. The overall performance of the method considering the area under the ROC curve (Receiver Operating Characteristics) was AUC = 0.84.

Master thesis

Title *Proposal of Radiation Dose Reduction in Digital Mammography Using new Algorithms for Poisson Noise Filtering*

Supervisor Marcelo Andrade da Costa Vieira

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Description The aim of this work was to present a novel method for removing the Poisson noise in digital mammography images acquired with reduced radiation dose. It is known that the X-ray mammography is the most effective exam for early detection of breast cancer, greatly increasing the chances of healing the disease. However, the radiation absorbed by the patient during the exam is still a problem to be treated. Some studies showed that mammography can induce breast cancer in a few women. Although this number is significantly low compared to the number of women who are saved by the exam, it is important to develop methods to enable the reduction of the radiation dose used in the exam. However, dose reduction led to a decrease in image quality by means of the signal to noise ratio, impairing medical diagnosis and the early detection of the disease. In this sense, the purpose of this study was to propose a new method to reduce Poisson noise in mammographic images acquired with low radiation dose, in order to achieve the same quality as those acquired with the standard dose. The method is based on well established algorithms in the literature as the filtering in Wavelet domain, here using Shrink-thresholding (WTST) and the Block-matching and 3D Filtering (BM3D). Results using phantom and clinical images showed that the proposed algorithm is capable of filtering the additional noise in images without apparent loss of information.

Undergrad thesis

Title *Development of a Framework for Optical Character Recognition*

Supervisor Marco Antônio Piteri

Description Was developed a whole pipeline software, written in C++ language with the library Qt, for preprocessing, feature extraction and recognition of texts in images. Several methods for feature extraction were implemented from scratch, for example Haralick measurements, as well as other methods based on this one considering different directions and radius.

Research Projects

2016-2018 **FAPESP Grant #2015/20812-5**.

Texture analysis exerts a key role in computer vision. However, the lack of a mathematical definition and a consensus taxonomy among various researchers made texture definition be based most often on heuristics. In this line of thought, the most efficient and modern descriptor is the Local Binary Pattern (LBP). This approach has proven to be quite effective considering the sensitivity, precision and accuracy in segmentation and classification of texture in digital images. However, in uncontrolled environments, most models fail and consume exorbitant computational time. Our proposal, named Local Mapped Pattern (LMP), is a generalization of LBP and has generated more robust results than the original LBP. It is a parametric model that needs to be investigated further to produce more efficient results an to increase its performance. In this work, we proposed the continuous development of LMP based on two actions: performance and computational time. In terms of performance, we propose developing descriptors to classify textures, with more accuracy than the results obtained by the LBP, both in mammographic images and in uncontrolled environments, where the texture could be rotated, colored and acquired with non-uniform illumination. In order to reduce the computational time, we propose to evaluate the reduction in size of the descriptors without loss of performance.

2014-2015 **FAPESP Grant #2013/18915-5**.

Digital mammography is considered the standard tool for early breast cancer screening in women over 40. However, the radiation dose received by the breast during screening mammography may induce cancer in some women, which adds to recent discussions about the risks and benefits of breast cancer screening. Efforts to reduce the radiation dose in mammography examinations are of great interest, due to the large number of asymptomatic women who are screened throughout the world each year. The radiation dose, on the other hand, directly influences mammographic image quality, as well as the performance of radiologists; a decrease in the dose leads to an increased quantum noise level, which may significantly degrade the image quality and the efficacy of the examination. Recent studies have shown that the quantum noise has a greater effect than the spatial resolution in the detection and classification of mammographic lesions by radiologists. Our proposed project is aimed at addressing this significant and timely clinical problem by the use of denoising techniques, which could allow for radiation dose reduction while keeping the image quality acceptable. Thus, the objective of this work is to study how denoising techniques can be adapted for filtering the quantum noise due to the reduced radiation dose in digital mammography. In addition, we will select the appropriate quantitative measures of image quality to calculate the percentage of dose reduction that, in combination with denoising techniques, would produce the same quality of images as those acquired with full radiation dose. This project was developed in collaboration with the X-Ray Physics Laboratory of the University of Pennsylvania, which provided the use of their anthropomorphic breast software phantom for preclinical assessment of the performance of denoising techniques.

Experience

Teaching Assistant

2019 **Course "SEL 0449 - Digital Medical Image Processing"**, *São Carlos School of Engineering (EESC) - University of São Paulo*.
Supervisor: Prof. Marcelo A. C. Vieira, PhD.

2018 **Course "SEL 0339 - Introduction to Computer Vision"**, *São Carlos School of Engineering (EESC) - University of São Paulo*.
Supervisor: Prof. Marcelo A. C. Vieira, PhD.

2015–2016 **Course "SEL 0339 - Introduction to Computer Vision"**, *São Carlos School of Engineering (EESC) - University of São Paulo*.
Supervisor: Prof. Marcelo A. C. Vieira, PhD.

2015–2015 **Course "SEL 0397 - Fundamentals of Medical Imaging"**, *São Carlos School of Engineering (EESC) - University of São Paulo*.
Supervisor: Prof. Homero Schiabel, PhD.

2015–2015 **Course "SME 0305 - Computational and Numerical Methods I"**, *Institute of Mathematics and Computer Sciences (ICMC) - University of São Paulo*.
Supervisor: Prof. Roberto Ausas, PhD.

2014–2014 **Course "SEL 0434 - Digital Radiological Images"**, *São Carlos School of Engineering (EESC) - University of São Paulo*.
Supervisor: Prof. Homero Schiabel, PhD.

2014–2014 **Course "SME 0800 - Probability I"**, *Institute of Mathematics and Computer Sciences (ICMC) - University of São Paulo*.
Supervisor: Prof. Jorge Bazan, PhD.

Co-adivising

2019 **Undergraduate Student - Scientific Initiation**, *"Filtragem do ruído de imagens mamográficas utilizando rede neural convolucional profunda"*, Leonardo Fernandes Oliveira, São Carlos School of Engineering (EESC) - University of São Paulo.
Supervisor: Prof. Marcelo A. C. Vieira, PhD.

2017 **Undergraduate Thesis**, *"Análise do comportamento do descritor de textura Local Mapped Pattern na classificação de distorção arquitetural mamária em imagens mamográficas"*, Gustavo Alves Reche, São Carlos School of Engineering (EESC) - University of São Paulo.
Supervisor: Prof. Marcelo A. C. Vieira, PhD.

2016 **Undergraduate Thesis**, *"Filtragem de ruído em mamogramas digitais utilizando filtro de duplo domínio"*, Fabrício de Almeida Brito, São Carlos School of Engineering (EESC) - University of São Paulo.
Supervisor: Prof. Marcelo A. C. Vieira, PhD.

2016 **Undergraduate Thesis**, *"Filtragem de ruído em imagens de projeção de tomossíntese mamária usando métodos não-locais"*, Roberto Martins de Freitas, São Carlos School of Engineering (EESC) - University of São Paulo.
Supervisor: Prof. Marcelo A. C. Vieira, PhD.

Event Organization

2015 **Scientific Event**, *XI Workshop de Visão Computacional - WVC 2015*, São Carlos School of Engineering (EESC) - University of São Paulo.
Chair: Prof. Marcelo A. C. Vieira, PhD.

2010 **Scientific Event**, *VI Workshop de Visão Computacional - WVC 2010*, State University of São Paulo.
Chair: Prof. Marco Antônio Piteri, PhD.

Voluntary Work

2019 **Technovation Summer School 2019**, *Institute of Mathematics and Computer Sciences (ICMC) - University of São Paulo*.

Languages

English Full Professional Proficiency.
Portuguese Native.
Italian Basic.

Computer skills

- Have strong skills in working with both Linux and Windows operating systems, computer vision, machine learning, as well as the programming languages: Java, C, C++, Python, MATLAB and LaTeX. Regarding the Python language, I have been using it specifically for Machine Learning/Computer Vision, thus I'm familiar with several libraries, such as: Numpy, SciPy, Matplotlib, Keras, Tensorflow, Scikit-Learn, Scikit-Image, Mahotas, Pillow and Pandas.

Publications: Journal Papers

[1] **Helder C. R. de Oliveira**, Arianna Mencattini, Paola Casti, Juliana H. Catani, Nestor de Barros, Adilson Gonzaga, Eugenio Martinelli, and Marcelo A. C. Vieira. A cross-cutting approach for tracking architectural distortion locii on digital breast tomosynthesis slices. *Biomedical Signal Processing and Control*, 50:92–102, 2019.

[2] Lucas R. Borges, **Helder C. R. Oliveira**, Polyana F. Nunes, Predrag R. Bakic, Andrew D. A. Maidment, and Marcelo A. C. Vieira. Method for simulating dose reduction in digital mammography using the anscombe transformation. *Medical Physics*, 43(6):2704–2714, 2016.

Publications: Conference Proceedings

[1] **Helder C. R. de Oliveira**, Carlos F. E. Melo, Juliana H. Catani, Nestor de Barros, and Marcelo A. C. Vieira. Exploratory learning with convolutional autoencoder for discrimination of architectural distortion in digital mammography. In *Medical Imaging 2019: Computer-Aided Diagnosis*. SPIE, 2019.

[2] Arthur C. Costa, **Helder C. R. de Oliveira**, Juliana H. Catani, Nestor de Barros, Carlos F. E. Melo, and Marcelo A. C. Vieira. Detection of architectural distortion with deep convolutional neural network and data augmentation of limited data. In *Proc. of XXVI Congresso Brasileiro de Engenharia Biomédica*, 2018.

[3] **Helder C. R. de Oliveira**, Arianna Mencattini, Paola Casti, Eugenio Martinelli, Corrado Di Natale, Juliana H. Catani, Nestor de Barros, Carlos F. Melo, Adilson Gonzaga, and Marcelo A. C. Vieira. Reduction of false-positives in a CAD scheme for automated detection of architectural distortion in digital mammography. In Kensaku Mori and Nicholas Petrick, editors, *Medical Imaging 2018: Computer-Aided Diagnosis*. SPIE, 2018.

[4] **Helder C. R. Oliveira**, Diego R. Moraes, Gustavo A. Reche, Lucas R. Borges, Juliana H. Catani, Nestor de Barros, Carlos F. E. Melo, Adilson Gonzaga, and Marcelo A. C. Vieira. A new texture descriptor based on local micro-pattern for detection of architectural distortion in mammographic images. In *SPIE Medical Imaging 2017: Computer-Aided Diagnosis*, volume 10134, page 101342U, 2017.

[5] Fabrício Brito, **Helder C. R. de Oliveira**, Predrag R. Bakic, Andrew D. A. Maidment, and Marcelo A. C. Vieira. Using bilateral filter to denoise digital mammograms acquired with reduced radiation dose. In *Proc. of XXV Congresso Brasileiro de Engenharia Biomédica*, 2016.

[6] Polyana F. Nunes, André Bindilatti, **Helder C. R. de Oliveira**, Lucas R. Borges, Predrag R. Bakic, Andrew D. A. Maidment, Nelson Mascarenhas, and Marcelo A. C. Vieira. Nova proposta do algoritmo de médias não-locais para filtragem do ruído quântico na mamografia digital. In *Proc. of XXV Congresso Brasileiro de Engenharia Biomédica*, 2016.

[7] **Helder C. R. Oliveira**, Bruno Barufaldi, Lucas R. Borges, Salvador Gabarda, Predrag R. Bakic, Andrew D. A. Maidment, Homero Schiabel, and Marcelo A. C. Vieira. Validation of no-reference image quality index for the assessment of digital mammographic images. In *Medical Imaging 2016: Image Perception, Observer Performance, and Technology Assessment*. SPIE, 2016.

[8] **Helder C. R. Oliveira**, Diego R. Moraes, Adilson Gonzaga, and Marcelo A. C. Vieira. Detection of architectural distortion in digitized screen-film mammograms using texture descriptors. In *Proc. of XII Workshop de Visão Computacional (WVC 2016)*, pages 260–265, Campo Grande/MS, 2016.

[9] Lucas R. Borges, **Helder C. R. Oliveira**, Polyana F. Nunes, and Marcelo A. C. Vieira. Method for inserting noise in digital mammography to simulate reduction in radiation dose. In *Medical Imaging 2015: Physics of Medical Imaging*. SPIE, 2015.

[10] Polyana F. Nunes, André Bindilatti, **Helder C. R. de Oliveira**, Lucas R. Borges, Predrag R. Bakic, Andrew D. A. Maidment, Nelson Mascarenhas, and Marcelo A. C. Vieira. Using the non-local means algorithm to denoise mammographic images acquired with reduced radiation dose. In *Proc. of XI Workshop de Visão Computacional (WVC 2015)*, São Carlos/SP, 2015.

[11] **Helder C. R. Oliveira**, Lucas R. Borges, Polyana F. Nunes, Predrag R. Bakic, Andrew D. A. Maidment, and Marcelo A. C. Vieira. Use of wavelet multiresolution analysis to reduce radiation dose in digital mammography. In *Proc. of IEEE International Symposium on Computer-Based Medical Systems*, pages 33–37, 2015.

[12] Marcelo A. C. Vieira, **Helder C. R. Oliveira**, Polyana F. Nunes, Lucas R. Borges, Predrag R. Bakic, Bruno Barufaldi, Raymond J. Acciavatti, and Andrew D. A. Maidment. Feasibility study of dose reduction in digital breast tomosynthesis using non-local denoising algorithms. In *Medical Imaging 2015: Physics of Medical Imaging*. SPIE, 2015.

[13] **Helder C. R. Oliveira**, Polyana F. Nunes, Lucas R. Borges, and Marcelo A. C. Vieira. Investigating the use of block-matching 3d denoising algorithm to reduce radiation dose in digital mammography. In *Proc. of X Workshop de Visão Computacional (WVC 2014)*, pages 224–229, 2014.

[14] Marcelo A C Vieira, Lucas R Borges, **Helder C. R. Oliveira**, and Polyana F Nunes. Método para simulação da redução da dose de radiação na mamografia. In *Proc. of XIX Congresso Brasileiro de Física Médica*, pages 5–6, 2014.

São Carlos, July 23^{th}, 2019.