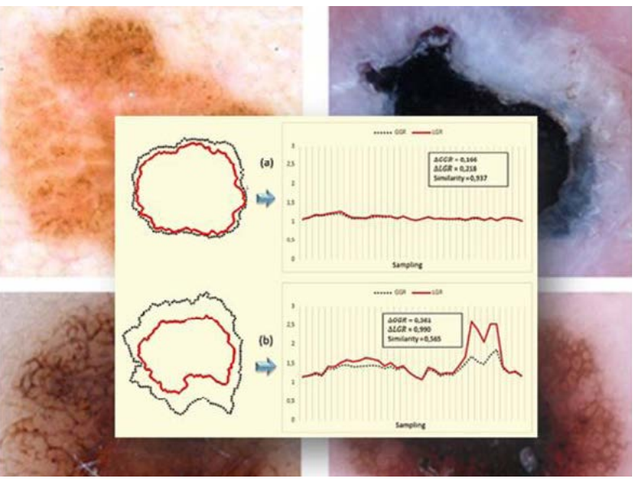
Feature Extraction and Artifact Removal in Dermoscopic Images

Skin cancer is one of the most common malignancies and the early detection of suspicious lesions is empowered by efficient and focused technology, which is based on Dermoscopy imaging. The main goal within this project is to propose quantitative markers for the assessment to lesion malignancy markers, and use these signs as features in automatic classification algorithms.



Main Project Team

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Funding Agencies

FEDER/QREN	**50,000€**
Start Date	01/01/2013
Ending Date	31/12/2014

Indicators

Book Chapters	1
Journal Papers	2
Conference Papers	4

Two Main Publications

M. Machado, J. Pereira, Fonseca-Pinto; **Classification of reticular pattern and streaks in dermoscopic images based on texture analysis**, Journal of Medical Imaging, Vol. 2, No. 4, pp. NA, October-December, 2015

A. Mendes, C. Nogueira, J.Pereira, R. Fonseca-Pinto, **On the geometric modulation of skin lesion growth: a mathematical model for melanoma**, Research in Biomedical Engineering, Vol. 32, No. 1, pp. 44-54, February, 2016

PROJECT WEBPAGE URL

https://www.it.pt/projects/index/1812

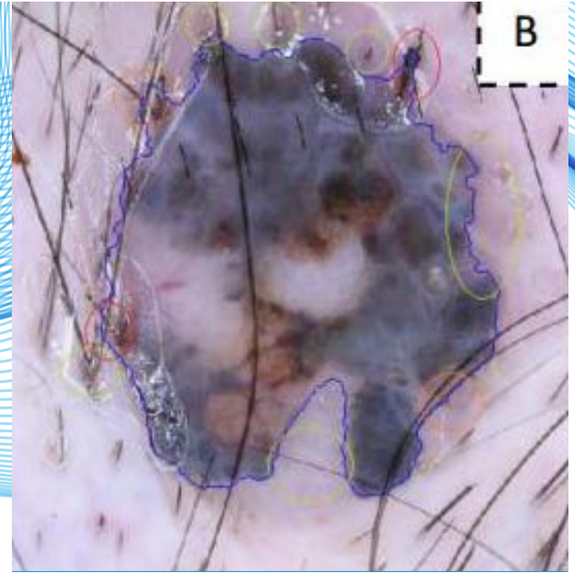

Fig. 1 Example of lesion segmentation from a dermoscopic image of the skull. In this example is possible to notice the common artifacts (hair and air bubbles)

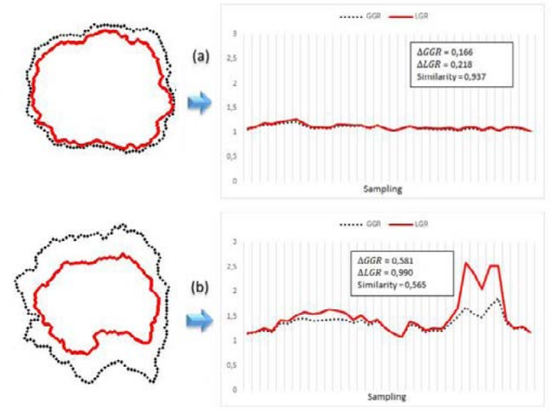

Fig. 2 Geometric markers obtained after alignment of the lesions in the same patient in different times

GENERAL MOTIVATION AND OBJECTIVES

To improve a quantitative clinical assessment diagnosis in dermoscopic images was the main motivation in this research project. This objective is closely related with the need of tools to access the dermatologist in the skin lesion classification challenge.

Artifact removal in dermoscopy is an important pre-processing task in order to maintain the key anatomical structures and this selective filtering is central to an accurate diagnosis. Automatic lesion border detection and feature identification is also crucial to follow the progression/regression of skin lesions, and to define markers as growth rate and boundary shape. This task is extremely dependent on the previous one, as the incorrect artefact removal (hairs and air bubbles) conducts to artificial borders, compromising diagnostic metrics.

Classification system of malignancy in lesions uses automatic feature identification (ABCD rule, and 7 point check-list) or other similar semi-qualitative approaches proposed by a few experts all over the world. Nowadays each diagnostic category within the realm of pigmented skin lesions is characterized by few global patterns and a rather distinctive combination of specific local features. Feature identification might help for the identification of diagnostic clues, and feature extraction also can be used to propose a quantitative measure of malignancy using geometric characteristics of lesion borders growth (linear, fractal, chaotic,...).

The project was divided in four tasks, performed by the following research groups:

· Task 1: Artifact removal - (IT/ MSP, Leiria)

· Task 2: Lesion border detection - (IT/ MSP, Leiria)

· Task 3: Feature identification - (Department of Mathematics ESTG / Polytechnic Institute of Leiria)

· Task 4: Automatic classification of skin lesion - (IT/ MSP, Leiria)

Apply selective filtering in dermoscopic images, maintaining diagnostic clues but also eliminating artifacts in Dermoscopic images

Use machine learning as an aid to medical diagnosis

CHALLENGE

To propose new geometric features in dermoscopy, whose inclusion in machine learning algorithms increases classifier performance;

To Introduce/approximate Medical community to Automatic classification algorithms

WORK DESCRIPTION AND ACHIEVEMENTS

In the first part of the work the methodologies for segmentation in dermoscopy were addressed. As a function of the characteristics among this type of images, a method was proposed based on the feature properties, lighting defects and local shape, defining a Multi-scale Local Normalization (MSL) methodology.

The results were disseminated through paper publications and oral communications.

This step was followed by the lesion border characterization using mathematical approaches for the growth (by linear transformations and also using dynamical systems theory). The project also established collaborations with other research lines in MSP-Lra group through a color study approach, and also by the use of automatic classification of the reticular pattern, whose identification is essential for diagnosis in dermoscopy.

The extracted geometric features joint with texture features, from the same dataset, were used in an international network of automatic learning partners with LABI from the Universidade do Oeste do Parana - Brasil.

Published work:

1. Pereira, J., Mendes, A., Nogueira, C., Baptista, D., Fonseca-Pinto, R.; An Adaptive Approach for Skin Lesion Segmentation in Dermoscopy Images Using a Multiscale Local Normalization; CIM Series in Mathematical Sciences: Mathematics on Planet Earth 2015 Dynamics, Games and Science, pp 537-545.

2. Machado M, Pereira J, Fonseca-Pinto R; Classification of reticular pattern and streaks in dermoscopic images based on texture analysis J. Med. Imag. 2(4), 12/ 2015;

3. Mendes A, Nogueira C, Pereira J, Fonseca-Pinto R; On the geometric modulation of skin lesion growth: a mathematical model for melanoma; Research in Biomedical Engineering, 32(1) ,03/2016.