

# Melanoma Decision Support System for Dermatologist

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## ABSTRACT

Malignant melanoma is nowadays one of the leading cancers among many white-skinned populations around the world. Malignant melanoma, the most deadly form of skin cancer, has a good prognosis if treated in the curable early stages. Early diagnosis is the most effective treatment of melanoma. Well-trained dermatologists reach a high level of diagnostic accuracy but their performance is increased by using computer aided numerical imaging tools. This study is limited in the use of simple image processing algorithms, for the sake of clarity, in order to illustrate the use of MATLAB in the calculation of the ABCD Total Dermatoscopy Score (TDS) for potentially malignant melanomas. A high ABCD score means that a lesion is more likely to be a malignant melanoma.

## Keywords

Melanoma, benign, suspicious, malignant, ABCD, Matlab, Dermatoscopy, image processing.

## 1. INTRODUCTION

As in recent years there has been a significant raise in the number of melanoma cases recorded world-wide, early diagnosis and efficient tools helping the dermatologists become a necessity. Melanoma is the most deadly variety of skin cancer. Although less common than other skin cancers, it is responsible for the majority of skin cancer related deaths globally [3]. Most cases are curable if detected early and several standardized screening techniques have been developed to improve the early detection rate [1], [2].

No computer application can provide a concrete diagnosis, but it can help inform the individual and raise the general awareness of this dangerous disease. The ABCD [8] allows for computation of so-called TDS factor (Total Dermoscopy Score). Four features of the image are taken into account:

1. Asymmetry – The dermoscopic image is divided by two perpendicular axes positioned to produce the lowest possible asymmetry score. If the image shows asymmetric properties with respect to both axes with regard to colours and differential structures, the asymmetry score is 2. If there is asymmetry on one axis the score is 1. If asymmetry is absent the score is 0.

2. Border – The images of the lesions are divided into eighths and a sharp, abrupt cut-off of pigment pattern at the periphery within one eighth has a score 1. A gradual, indistinct cut-off within one eighth has a score of 0.

3. Colour – Six different colours: white, red, light-brown, dark-brown, blue-gray, and black, are counted in the color score. White is only counted if the area is lighter than the adjacent skin. Cancerous skin changes are usually characterized by three or more colours. About 40% of melanomas have five or six colours are present.

4. Diameter – diameter greater than 6 mm. Once the ABCD values are evaluated for the image under consideration one can compute the TDS (Compute Total Dermatoscopic Score) /TDV (Compute Total Dermatoscopic Value) factor:

$$TDS = A*1.3 + B*0.1 + C*0.5 + D*0.5$$

$TDS < 4.75$  gives indication of a benign lesion,

$4.75 < TDS < 5.45$  is non conclusive while  $TDS > 5.45$  gives strong indication that the lesion is cancerous.

## 2. BACKGROUND

Melanoma develops in the *melanocyte* skin cells responsible for producing the pigment *melanin* which gives the skin, hair, and eyes their colors. Early stages of the cancer present themselves as irregular skin lesions. Detection techniques for early stage melanoma use the morphological characteristics of such irregular skin lesions to classify risk levels.

## 3. IMAGE PRE-PROCESSING & SEGMENTATION

The techniques used to compute relative risk scores follow an image-processing pattern similar to that of any feature extraction algorithm. Images are preprocessed, a region of interest (feature) is identified, and then individual feature descriptors are run on the region of interest. The results from a MATLAB implementation of the score computation were analyzed by a group of trained dermatologists.

### 3.1 Preprocessing

Once a magnified image of a skin lesion is captured it is passed to a preprocessor. The preprocessor performs global image binarization via Otsu's method [4]. Following binarization, a connected components analysis is performed and small region removal for both positive and negative regions removes most of the image noise. A sample output from the preprocessing stage is shown in Figure below:

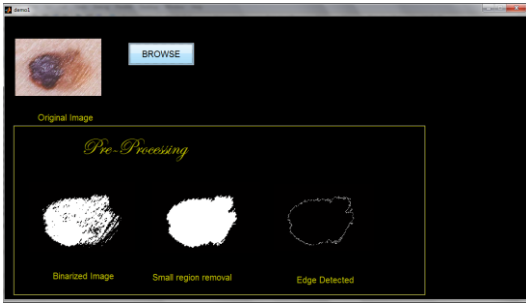


Fig 1: Illustrating the pre-processing

### 3.2 Image Segmentation

Following binarization and denoising in the preprocessor, the region representing the skin lesion is segmented from the rest of the image. Most medical imaging is designed to maximize the percentage of an image's field of view devoted to its subject, so the largest component in the preprocessed images is nearly always the lesion. Occasionally large shadows in the images were mistaken for a lesion so a maximum allowable lesion size restriction was imposed. A sample output from the preprocessing stage is shown in Figure below:

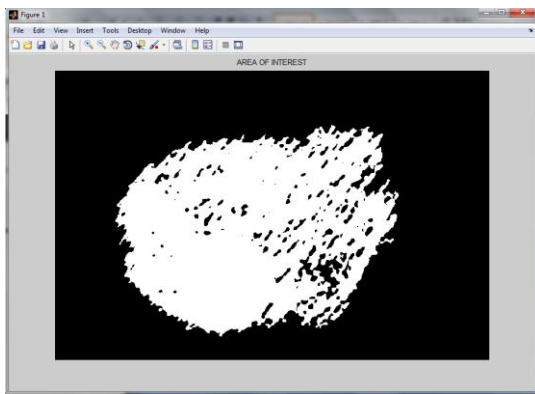


Fig 2: Area of interest

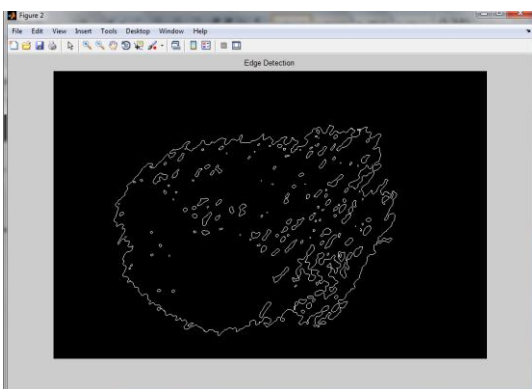


Fig 3: Edge Detected

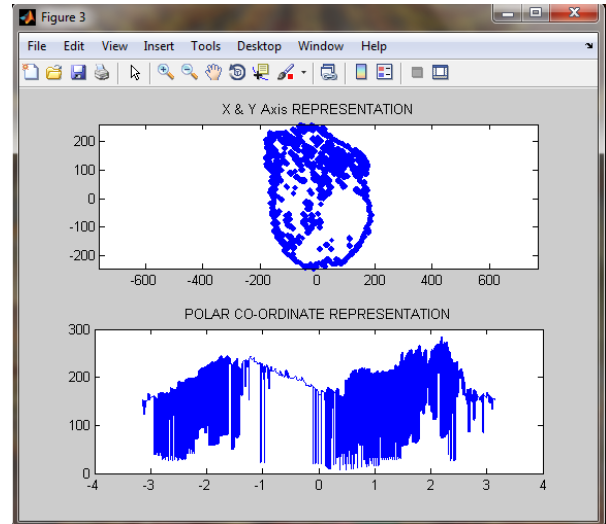


Fig 3: X & Y axis Representation, Polar Co-ordination

## 4. MORPHOLOGICAL FEATURE DESCRIPTORS

### 4.1. Asymmetry

After preprocessing and segmentation, the images are ready for analysis by the individual feature descriptors. Three feature descriptors inspired by the “ABCDE” skin self-examination form the core of the risk assessment. Those features are asymmetry, border, and color. In [1], a lesion is considered potentially cancerous if “one half is unlike the other half.” This guidance is relatively vague, so techniques developed for dermatoscopy were used for inspiration. The asymmetry score calculation is based on the symmetry map technique presented in [5]. Symmetry maps encode a measure of a region's symmetry, known as symmetry metric, relative to a range of axes of symmetry defined by angle. Lesion color and texture comparisons were used to encode symmetry in [5]. Commonly the symmetry metric is a function of distance  $R$  from a region's center. In [5], a symmetry map is created for the range of symmetry axes passing through a region's center with angles ranging from 0 to 180 degrees. Unlike color or texture, borders exhibit a better invariance to imaging conditions.

To exploit this property an inclusion metric was devised. For each pixel belonging to a lesion region, a counter was incremented if that pixel's mirror about a specified symmetry axis was also included within the lesion region. After each pixel was examined the inclusion counter was normalized by the number of pixels in the lesion region.

The inclusion metric is analogous to a probability score between 0 and 1 that a given pixel will have a mirror. It is also not a function of distance  $R$  from the region's center.

The inclusion symmetry metric was computed for the axes passing through a region's centroid at angles of 0, 45, and 90 degrees as shown in to form a “sub sampled” symmetry map. At these angles, the inclusion metric can be computed quickly using matrix index arithmetic and a binary mask of the region of interest. As with the conventional symmetry maps, the maximum symmetry score over all three angles was taken as the lesions symmetry. For convenience, the score was converted to units of asymmetry by subtracting it from 1. In general a lesion with a high asymmetry score is at a higher risk of being cancerous.

## 4.2 Border

In [1] the shape and strength of a region's border are considered collectively when assessing risk but the automated algorithm examines only border strength. This is because the simple segmentation techniques used were a relatively noisy measure of a lesion's boundary and the segmentation noise quickly corrupts any border shape metric. However, border strength is relatively easy to compute. Using the gradient-of-Gaussian edge detection kernel developed by Canny in [7], a smoothed map of an image's intensity gradient is computed via 2D convolution. The intensity gradient map can also be computed using a two-stage filter combination of Sobel and Gaussian kernels. Proper choice of the Gaussian smoothing kernel is important given the relative inaccuracy of the lesion segmentation. If too small a kernel is used, the border pixels may not fall directly over pixels with a high gradient magnitude.

## 4.3 Colour

To reduce variability, all lesion images were converted to grayscale before scoring. The standard deviation of the grayscale intensity values of all the pixels belonging to lesion regions was calculated. This standard deviation value was taken as the color variation risk. In general, lesions with a higher color standard deviation are considered to be a higher cancer risk.

## 4.4 Diameter

Melanoma tend to grow larger than common moles, and especially the diameter of 6mm. Because the wound is often irregular forms, to find the diameter, drawn from all the edge pixels to the pixel edges through the mid-point and averaged.

## 4.5 Evaluation

Dermatologist will give input to the system about the location of lesion. With respect to the location it will give the type of melanoma. A sample output is shown in Figure as follows:



Fig 4: Evaluation

## 5. CLASSIFICATION

Based on TDV, the value obtained has the following conclusion and accordingly can be classified:

1.00 – 4.75 – benign skin lesion

4.75 – 5.45 – suspicious melanoma

More than 5.45 – malignant melanoma

## 6. FINAL DIAGNOSIS

The final output given by the system will help the dermatologist to detect the lesion and its type, accordingly with his knowledge he will examine the patient to draw a final conclusion whether it can be operated or not or any other way to cure it for e.g. using medicines or ointments, etc. Melanoma Decision Support System will help Dermatologist to diagnose melanoma in early stages.

## 7. REFERENCES

- [1] Stolz W, Riemann A, Cognetta AB. ABCD rule of dermatoscopy: a new practical method for early recognition of malignant melanoma. *Eur J Dermatol* 1994; 4:521-7
- [2] G. Argenziano, C. Catricala, M. Ardigo, P. Buccini, P. De Simone, L. Eibenschutz, A. Ferrari, G. Mariani, V. Silipo, I. Sperduti, I. Zalaudek. Seven-point Checklist of Dermoscopy Revisited. *The British Journal of Dermatology* 2011; 164(4):785-790
- [3] Parkin D, Bray F, Ferlay J, Pisani P. Global
- [4] Otsu N. A Threshold Selection Method from Gray-Level Histograms. *IEEE Transactions on Systems, Man, and Cybernetics*. 1979. Vol. 9 Issue 1:62-66.
- [5] Schmid-Saugeon P, Guillod J, Thiran JP. Towards a computer-aided diagnosis system for pigmented skin lesions. *Computerized Medical Imaging and Graphics* 2003. 27(1):65-78