SKIN CANCER DIAGNOSIS USING FRACTAL DIMENSION

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Abstract.

Nowadays the deterioration of the ozone layer is one of the most serious environmental problems our planet is facing, this deterioration is affecting many people around the world because the sun's radiation is stronger every year. Skin cancer can occur anywhere on the body but is most common in skin that has been exposed to sunlight, we might say when cancer is detected early, treatment is more likely to work better.

This paper describes the application of fractal geometry for the diagnosis of skin cancer based on measurements of mole samples: normal and irregular fractal dimension. This method uses the Koch curve to capture some sampleôs characteristics, we are talking about attributes of measurement and degree of irregularity in order to classify and determine its type. For this purpose, weôll preferably use higher resolution images[2] (3 Mega pixels) and convert them to grayscale format so we can be able to process them easily.

1. Methodology

The fractal analysis is an optimal technique to find a reliable diagnosis of skin cancer because it's proved that we obtain more accurate results than when we use a simple Euclidean line to measure the irregularity of objects. This is the reason why this study explores the Koch[1] curve, with some of their necessary characteristics like being able to measure infinite length, infinite surrounding area and fills the spaces that haven't been previously analyzed. With this method, we aim to obtain accurately results providing an optimum response.

To get a proper analysis, first we've used a procedure to convert an image to grayscale, then we find its histogram calculating and applying the Otsu Threshold method and binarizing the images to obtain samples with defined contour.

Once the outline is defined, we can obtain the fractal dimension by applying the method of counting boxes (box counting) which is based on the calculation of boxes needed to cover an object completely, this is done by superimposing a grid dividing the sample into blocks of side boxes "r", then counting the number of boxes N (r) where at least one pixel is occupied. We evaluate through different size of boxes and the variation in N (r) with respect to "r" is the indicator of complexity of the sample.

Finally, to calculate the box counting dimension we evaluate the expression log (N (r)) against log (r), thus obtaining the degree of complexity (Db) of the sample to be able to quantify and to compare with the results of the healthy samples, with this classification we'll have the facility to determine whether a mole image sample is benign or malignant.

$$D_b = -\lim_{r \to \infty} \frac{\log_{10} N(r)}{\log_{10}(r)}$$

Image1. Formula to find the fractal dimension

2. Theoretical Foundation

This project could help to detect cancer disease for early treatments, we know they work better when are discovered at time.

It's known that cancer generates moles or melanocytic nevi, these abnormal cells are pigmented spots on the skin and are usually brown and may have different sizes and shapes. The brown color is due to melanin pigment produced by melanocytes in the skin. To differentiate their characteristics before sorting, we have to summarize the ABCD[3] rule to recognize the symptoms of melanoma:

• Asymmetry: One half of the abnormal area is different from the other half.
• Borders: The lesion or growth has irregular edges.
• Diameter: The trouble spot is usually but not always greater than 6 mm diameter.

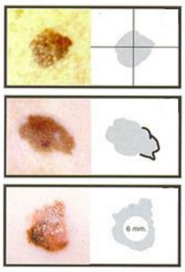

Image2. a) Asymmetry. b) Borders. c) Diameter

Once we've recognized most of the lunar features that could trigger a cancer disease, is essential to know the different types of melanoma in order to accurately classify and diagnose:

- Lentigo maligna: Initially perceived a spot of ill-defined edges.
- Superficial spreading surface: It's a superficial stain with well-defined borders. The shape of the edge is irregular.
- Acral: Have the scattered edges.
- Congenital nevus and dysplastic or atypical: When is larger than 2 cm it has an increased risk of developing melanoma.

Knowing about the characteristics of this disease, we can sort and find diagnostics fast and more accurately.

3. Results.

Researching on the processing samples with the developed method, we've obtained an average size of most healthy samples and have found as a result that none of the healthy samples have higher fractal dimension of 1.28.

4. Conclusions and recommendations.

- The Box-counting method is undoubtedly the most widespread method in the scientific literature and has the advantage of being applied to any distribution of points, curves, surfaces, volumes.
- This analysis reveals complex morp hological structures with more details as the fractal dimension is a measure of complexity of a figure similar car and capture the degree of irregularity of these samples in order to diagnose based on the result.
- This morphological complexity analysis reveals structures in more detail, because the fractal dimension is a measure of complexity of an auto similar figure and will capture the degree of irregularity of these samples in order to diagnose based on the obtained result.

5. References.

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