THE WAY TO ENSURE THE DIAGNOSIS OF INJURY SUGLOBS BY MEANS OF FRACTAL GEOMETRY

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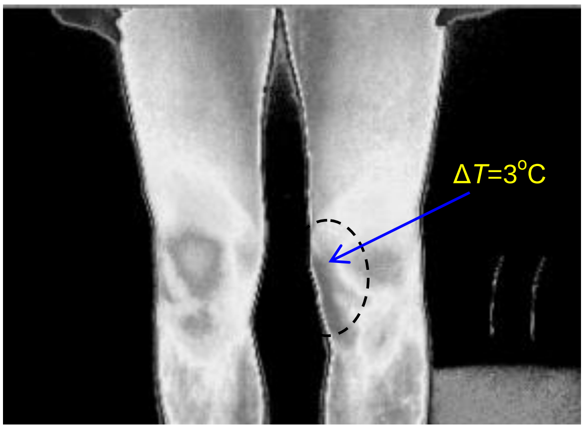
***Summary.* In this work considers the description of the fractal approximation of injuries suglobs. Using fractal approximation becomes possible to establish the diagnosis of the disease. Establishing the accuracy of fractal approximation allows to predict with some degree of probability of the further development of the disease.**

***Keywords:* fractal approximation, joint damage, fractal dimension, symmetry.**

Formulation of the problem. Setting accuracy fractal approximation termohramy joint damage zone makes it possible for computer diagnostics and patient diagnosis.

Analysis of recent research. In [1] investigated termohramy patients of different pathologies and at different stages of the disease. Fig. 1, and the patient presented thermogram when the complaints were typical injury medial meniscus of the left joint.



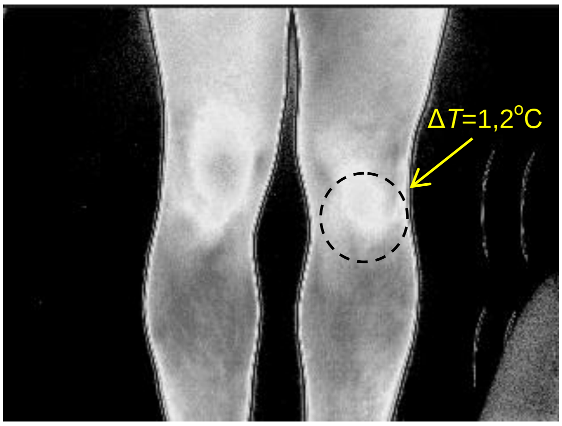


Fig. 1. Termohramy lower extremities of patients with damage:
a - parakapsulyarnyy gap medial meniscus of the left knee joint;
b - periarthritis left knee.

The examination fever were registered on the medial surface of the left joint (highlighted area) compared to the symmetrical area on 3°C. Diagnosis specialist - parakapsulyarnyy gap medial meniscus of the left knee. Thermogram patient with knee periarthritis shown in Fig. 1b. The difference in temperature on the front surface of the knee joint (highlighted area) compared with healthy is 1,2°C.

In [2-3], the algorithm for the mathematical description of fractal geometry representation methods and way of counting accuracy fractal approximation.

Apparatus fractal geometry can provide approximate mathematical description of areas of high temperature and depending on the accuracy of approximations fractal set of disease.

Forming the purposes of Article. Explore the fractal dimension areas with high temperature based termohramy. Using fractal dimension approximate a given area and deterministic fractal calculate this approximation accuracy.

Main part. Consider termohramu areas of the body with parakapsulyarnym gap medial meniscus of the left knee joint (Fig. 2). For this area is characterized by fuzzy contours and the presence of symmetry [1]. Symmetry allows you to use the plot device of fractal geometry. The application of fractal geometry to describe termohramy provides new opportunities to study the disease and its prediction.

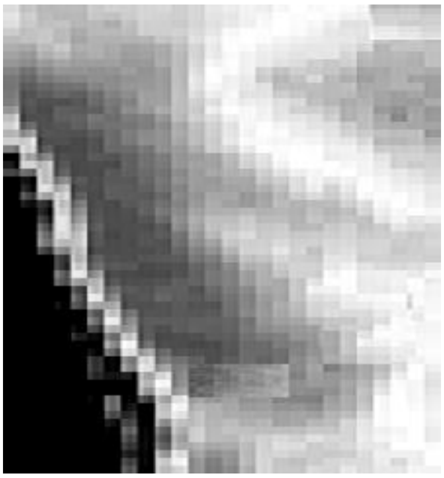


Fig. 2. Image Land parakapsulyarnoe gap medial meniscus left knee.

To install the fractal dimension the object under study covered by *n*-dimensional cells, where n is determined Euclidean dimension nian *k* from dimension *n=k-1*. Fractal dimension is determined from the ratio

$$N(l) \approx l^{-D}, \qquad (1)$$

where D – fractal dimension, l – Length side of the cell (in this case cell area with sides l), $N(l)$ – number of cells needed to cover.

Note

$$N(l) \approx l^{-D}(l), \quad D \approx log_{l(l)} N(l), \quad D \approx log_{l(l)} N(l)^{-1}.$$

To figure had required input format and size apply fractal graphics. This transition will without losing image quality zoom in or out.

To find the $N(l)$ use the algorithm:

1. Scope dx-dy ($dx=x_{max}-x_{min}$, $dy=y_{max}-y_{min}$), in which pixels are covering the path to divide the cell. The length of the cell $l = \frac{dy}{N_y}$, where N_y – the total number of partitioning and limited value l 2 pixels for reasons of quality.

2. Find the numbers of cells that cover the affected skin and calculate the number Nl.
3. We carry out checks on cells via conjugation ratio $\left[(i_x, i - i_x, i+1) + (i_y, i - i_y, i+1)\right] = (1,1,1)$. For non-conjugated cells calculated number of supporting elements $N_{\partial on.}$, $N_{\partial on.} = \left\lfloor \sqrt{(i_{x+1} - i_x)^2 + (i_{y+1} - i_y)^2} \right\rfloor$.
4. Expect $N(l) = N_l + N_{\partial on.}$ for a selected value *l*.
5. Using the regression equation by least squares, built straight $y = kx + b$ corner where k-factor that determines the fractal dimension.

Outline view in a constant scale. Step zoom accept the size of the broken link *l*, the length *L(l)* is found in the same way as *N(l)*. Square *L* is found by summing all areas that come to the affected part of the skin.

Finding the fractal dimension given way makes it possible to find the fractal dimension of the entire affected area.

The algorithm is implemented in the programming language Delphi, where the input is an image of the affected area, and cell length *l*. It was found that the length of the cell bounded by 2 pixels fractal dimension is 1.783 (Fig. 3).

Setting the fractal dimension, made it possible for fitting area fractal set of algebraic Julie, which is subject to the law $z_{i+1} = z_i^2 + c$, where *c* – constant. Accuracy approximation Fractal 0.12.

We use this algorithm for the zone periarthritis of the left knee joint.

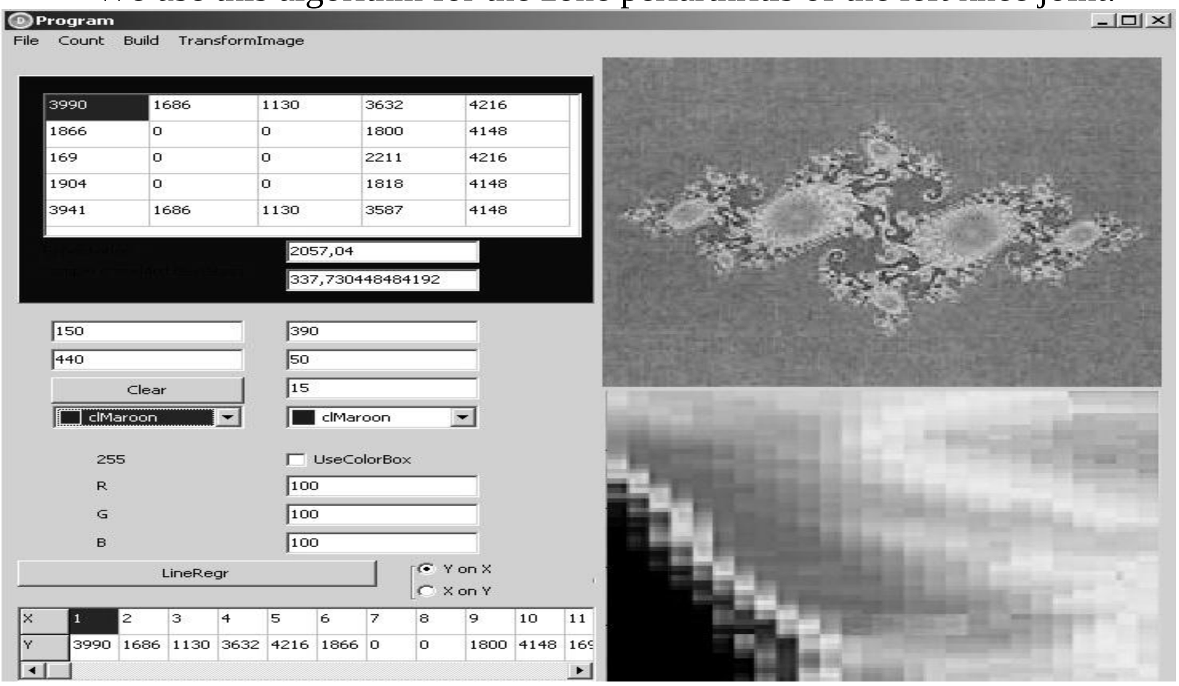


Fig. 3. Fractal approximation termohramy areas of the body with parakapsulyarnym gap medial meniscus of the left knee joint.

Based on the algorithm found that the fractal dimension area is 1,971 approximated stochastic and fractal "Plasma". The accuracy of this approximation 0.08.

Thus, one could argue that the probability of disease is 0.88 parakapsulyarnym gap medial meniscus of the left knee joint, provided that it thermogram approximated by a plurality of Julie and with probability 0.92 - periarthritis left knee when thermogram approximated stochastic fraktalom- plasma.

Depending on the fractal dimension and fractal approximation accuracy is the ability to predict the further development of the disease.

Conclusion. Setting fractal approximation and the accuracy of the approximations made it possible diagnosis and computer processing termohramy the affected joint.

Literature

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