Fractal analysis 3D the structure of geometrical surface

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Abstract
The intensive development of advanced technologies show the essential influence the structure of geometrical surfaces (SGP) on usable values of elements. The parametral opinion of surface in result to use of computer aided of analysis surface in three-dimensional arrangement (3D) can to be inference about state this surface, the prognoses the propriety of exploational articles as well as to serve of optimization of cutting parameters. The opinion of row of additional parameters the structure of geometrical surfaces (SGP) is possible it is to serve of utilization the technique of computer aided of analysis painting as well as size what "fractal dimension ”

Keywords
use of computer analysis 3D, the opinion of structure of geometrical surfaces (SGP), fractal analysis

1. Introduction

Appointed “fraktal ” *fractus* come from Latin language, with word - "broken," "partial ”. Object marks, which frequent they are similar to the whole (object similar). Mathematicians define “fractal”, as gathering which possesses not trite structure in every scale. Gathering this is similar what the description him in language of traditional Euclid’s geometry makes difficult, if not in exact sense this in stochastic or approximate. Example “fractal” two-dimensional according to [1] it represents (fig. 1)

a) b)

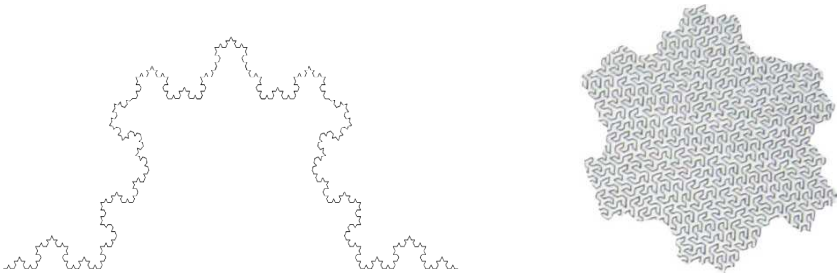

Fig. 1 Examples “fractal” two-dimensional [1]. a) curves Kocha, b) curves Gospera.

Function is the most popular description of surface or profile Weierstrassa - Mandelbrota expressing following example (1):

$$z(x) = G^{D-1} \sum_{n=n1}^{\infty} \frac{cos(\gamma^n x + \emptyset_n)}{\gamma^{(2-D)n}} \qquad (1)$$

where: ϕ_n - phase random,

γ - coefficient of scale.

Round applying “fractal” growed many controversies, last tests to today however. It was one should first of all give me question it or use “fractal” was it been possible was to use to every surface?. It in aim of description of breakthroughs or different free surfaces or internal the fractal methods, were used was, which permit in many cases on distinction the breakthroughs about different morphology ale they have to possess the same value of parameter *RL*(figh. 2). The processes of cracking in microscopic scale, possess the accidental character, which is particularly useful to use of fractal analysis [2]. In literature are regarding also the fractal description of surface after EDM, gridding and also the waste [1].

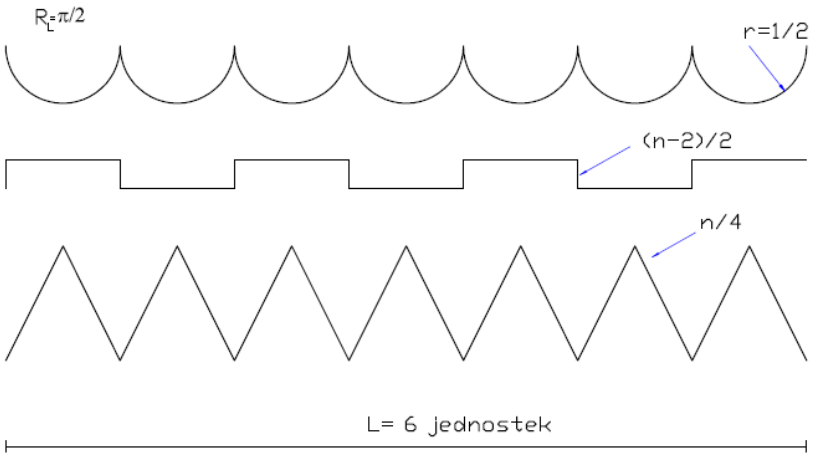

Fig. 2. Profiles model about equal coefficients *R* [1]

According to authors [2,5] “fractal” to divide on two groups mighty:

- not stochastic (not accidental),
- stochastic (accidental)

Not stochastic “fraktal” they belong to mathematical objects, formed on road of next iterations. Example of this type of formation the “fractal” is the triangle Sierpińskiego

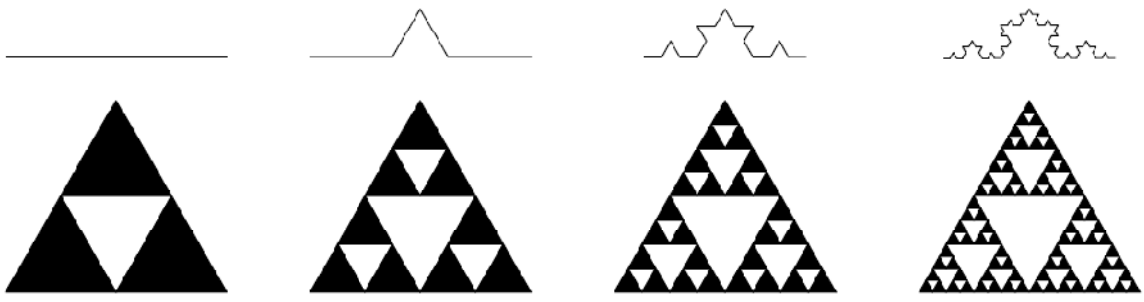

Fig.1 Not stochastic in triangle Sierpińskiego

In second case, stochastic objects (accidental), which are not they “fractal” step out in nature often. They sure possess property, as (thickness), which it diminishes in wide range liniowo, together with from enlarging if we will introduce it on doubly logarithmic graph.
The basic technique of delimitation of dimension, the construction the doubly logarithmic graph, dependence of length of line profile from increase is (the resolution) or the size of measuring step. He represents the equation (2) the line of straight line about negative direction coefficient the *c*.

$$\log[L(x)] = c\ logx + b \tag{2}$$

where: *L(x)* – length of profile dependent from size of measuring step
c – of straight line connected with fractal dimension D. direction coefficient

Author [2,5] it quotes several methods of delimitation of length of line of profile. The method of bowstrings is one of them(prostate, Divider Method or Commpass Method)- profile be replaced bowstrings about solid length. Initial points and final they should be identical for different measuring steps (outline 1.4).

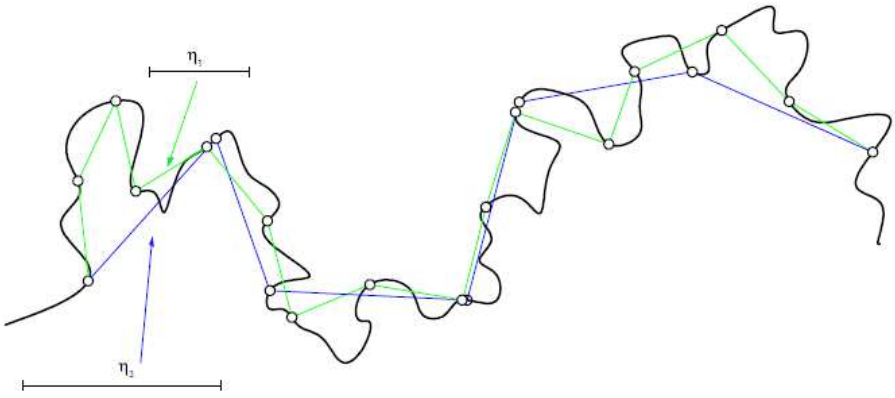

Fig. The interpretation of curve with the help of the broken about different lengths of measuring step line

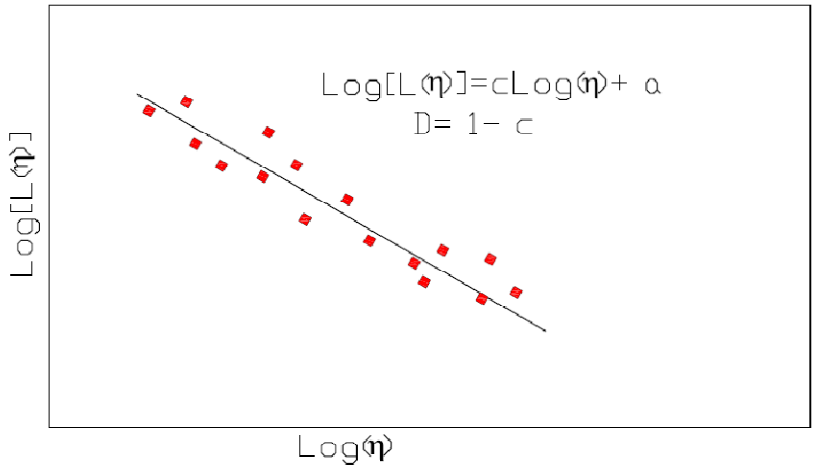

Fig. 4. The delimitation the fractal dimension the method of bowstrings [2]

Different method of measurement of length line - depends on putting the square meshes about different lengths of side (*Box - Counting Method*). In this way the pictured function on graph represents the number of squares (the size of square mesh) cut by profile of breakthrough (fig. 5).

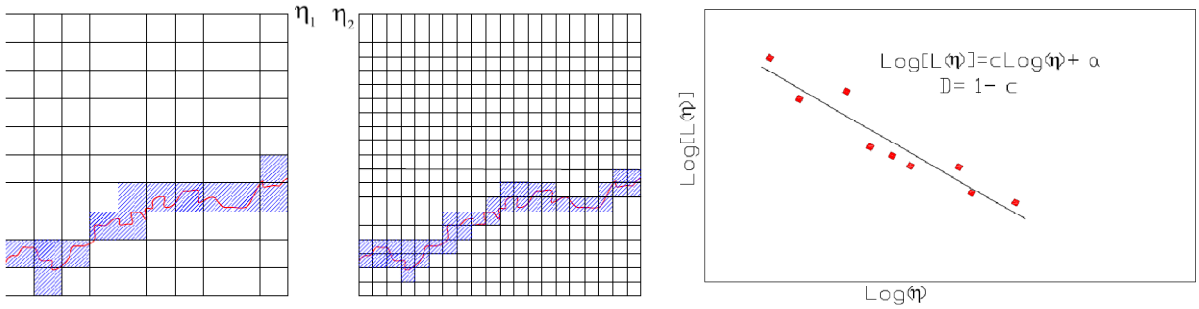

Fig. 5. Delimitation fractal dimension method *Box – Counting* [2]

2 The computer analysis image of Structure of Geometrical Surface (SGP)

To delimitation of fractal dimension of structure of geometrical surface (SGP) the computer techniques of computer analysis image were used was [6]. The computer analysis - then the process of processing of information, where it is the entrance data the offences and exit they have the different form (the numbers, board of numbers, decision, text.)
The processing working on image analysis - then the process of processing of information, where the data are the entrance information, as and exit in figure of image.
Computer systems to this aim serve, which have considerable superiority over man under regard: the speed of analysis, resistance on fatigue. They from this title system such according to [2] found wide use min. in:

- science about materials(the opinion of size of grains),
- medicine the (analysis of image from scanner)
- detection (satellite and air image)
- control of quality
- automatic sorting correspondence.

3 Filters

Filters serve to cleaning with different kinds of hums signal, accidental formed in studied temporary course disturbances. Filtration usually depends on removal value, which they are sale large or sale small. The idea of process of filtration according to [2] be introduced on (fig. 6).

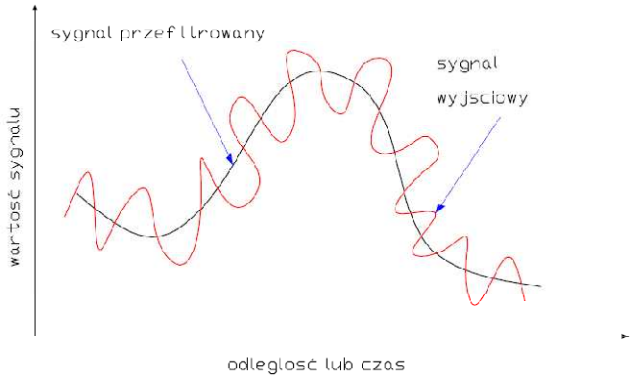

Fig. 6. Idea of process of filtration [2]

4 Analysis 3D spatial image

It by analyse 3D was it been possible was to receive precise information about size, shape and position spatial in analysed object [6]. We get thanks of this type investigations true shapes and distribution in spaces of studied material (fig. 7)

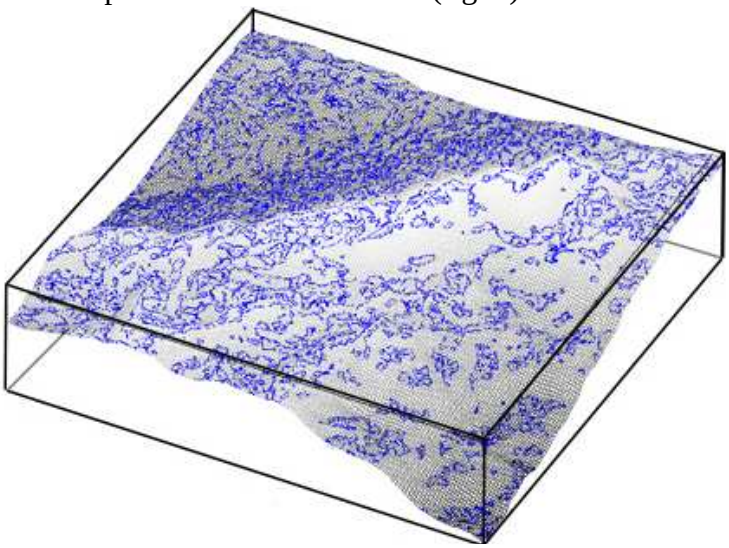

Fig. 3D image size grains

Aphelion (fig. 8) it is advanced platform, which serves to processing of image.

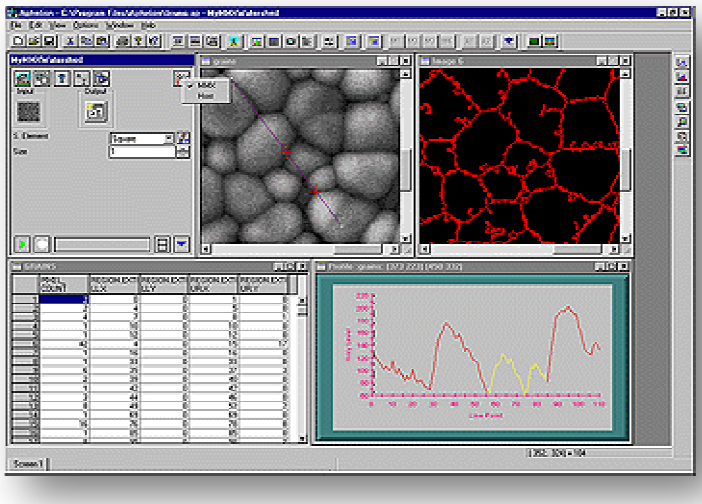

Fig. 8 The panel of programme Aphelion.

It the Aphelion is the software to processing of painting and quantitative analysis the servants to quick the prototypowania of application as well as development of new techniques illustrating. Paintings analysed in Aphelionie they can be binary, grey, or colourful.

5 Delimitation fractal dimension method Box - Counting

The basic technique of delimitation of dimension, the construction the doubly logarithmic graph, dependence of length of line profile from increase is (the resolution) or the size of measuring step. Analysis this was introduced in form of graphs (fig. 9 ÷ 15). It for basis delimitation fractal dimension was accepted was of measuring step even size 2 µ m.

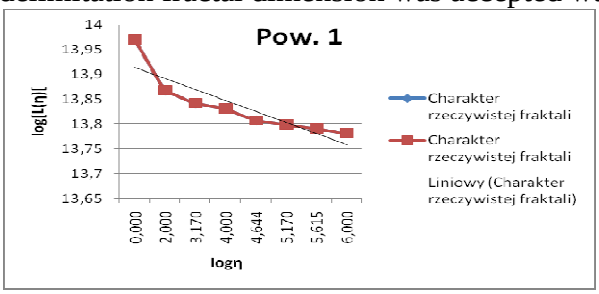

Fig.9 Fractal dimension on surface 1

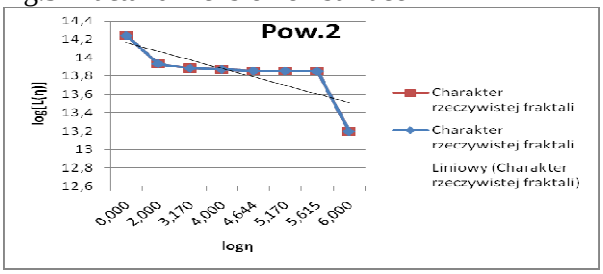

Fig.10 Fractal dimension on surface 2

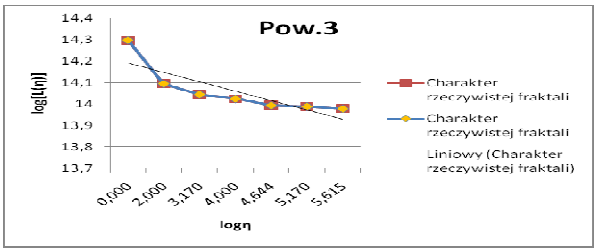

Fig.11 Fractal dimension on surface 3

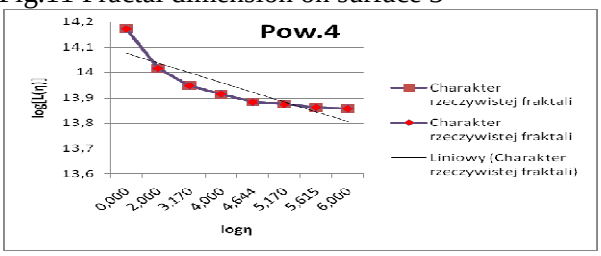

Fig.12 Fractal dimension on surface 4

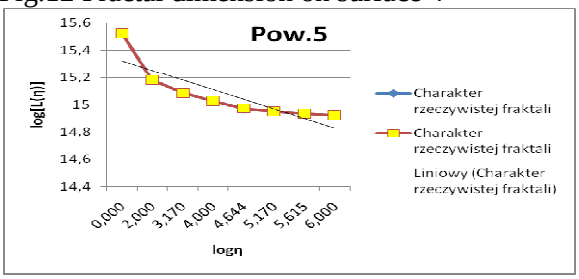

Fig.13 Fractal dimension on surface 5

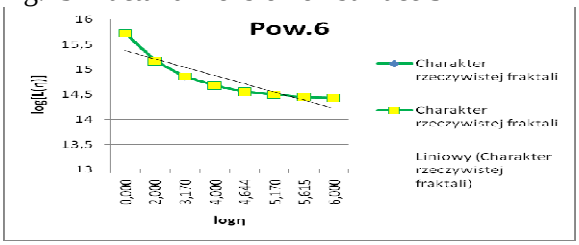

Fig.14 Fractal dimension on surface 6

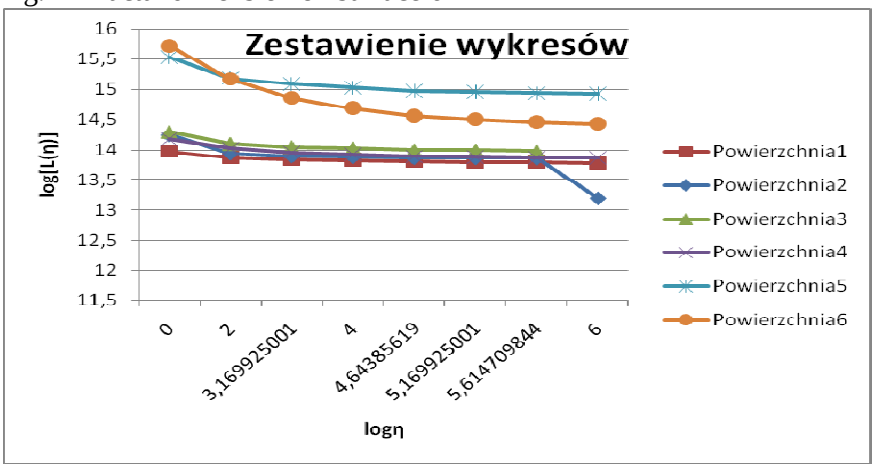

Fig. 15 Fractal dimension of six studied surfaces

Summary

With analysis results, that near changing parameters of processing, the fractal dimension contains in compartment 0.60 ÷ 1.69. The change of conditions of processing causes in received arrangement of reference the change of value of fractal dimension and position graph.

The choice of length of measuring step is the decisive problem. She in conducted investigations was then value 2 μ m. It suitable selection of this value is dependent from shaped the SGP the as well as possibility computational surfaces of computer equipment.

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