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SURFACE QUALITY MODELING USING DISTRIBUTION PARAMETERS OF ROUGHNESS TO THE PROCESSING MAGNETO-ABRASIVES

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ABSTRACT: Machined surface quality is considered a general objective function, the technological, which is a meeting basic functions, among which the most important is the geometric condition. In turn, the geometric condition is characterized primarily by geometric deviations of order 3 and 4, which define the surface roughness. Given these and magneto-abrasive processing capacity to generate very fine surfaces is justified interest to study the quality of machined surfaces with roughness parameters
KEY WORDS: modeling, levitation, rheological abrasive medium, experimental modeling, roughness parameters

1. INTRODUCTION

Peculiarities processes magneto-abrasive processing and analysis of experimental models highlight a number of issues but especially antithetic random influences, making roughness is, from the geometric random nature.

Determination of roughness parameters and their distribution is based on profilogram areas through detailed analysis of the graph roughness or using specialized microprocessors connected to profilometers [2].

To measure objective function values of roughness, the experimental model is used initially roughness type tools. These instruments are piezoelectric transducer through signal processing provides information only about the parameter R_a. More complete information about machined surface roughness can be obtained by establishing the roughness on a complex stand using specialized software.

2. DESCRIPTION OF THE ROUGHNESS MEASURING STAND

The schematic diagram of the stand is shown in Fig.1. The main elements of the stand structure are:

- Piece fastening system measured;

- Roughness with Probe - piezoelectric transducer, sample peck is conical type of diamond probe is mounted on a flexible blade to provide necessary pressure on palpation;

- Driving system of touch sensor, which consists of an electric motor and a speed reducer that provides two gears;

- Profilometer which is designed to handle the roughness gaves preliminary signal to be acquired by data acquisition board;

- Data acquisition board, which is designed to retrieve data from the profilometer and turn them into digital signals;

- Electronic computer, with the purpose to retrieve data from the data acquisition board, for further processing.

This plate is of type AM - M10 - 16XE50 and along with the computer software, is part of a system of data acquisition and their processing firm National Instruments called Virtual Bench. From the library of this instrument programs is applied Virtual Bench program - Logger.

3. DATA PROCESSING OF THE AQUIRED DATA AND PLOTTING PROFILE CURVES

With previous stand of measurement and data acquisition presented above, work-pieces default values influence factors are the focus of matrix-program experiments and are presented in Table 1.

It can be noted that the software used provides output matrix files with extension "log" (logger) channel recordings has been done has an independent variable in size time (milliseconds) and the dependent variable supply voltage (millivolts). The data obtained were processed in Microsoft Excel.

Given these acquired data processing was done in the following steps:

- Saving files acquired with extension "log";

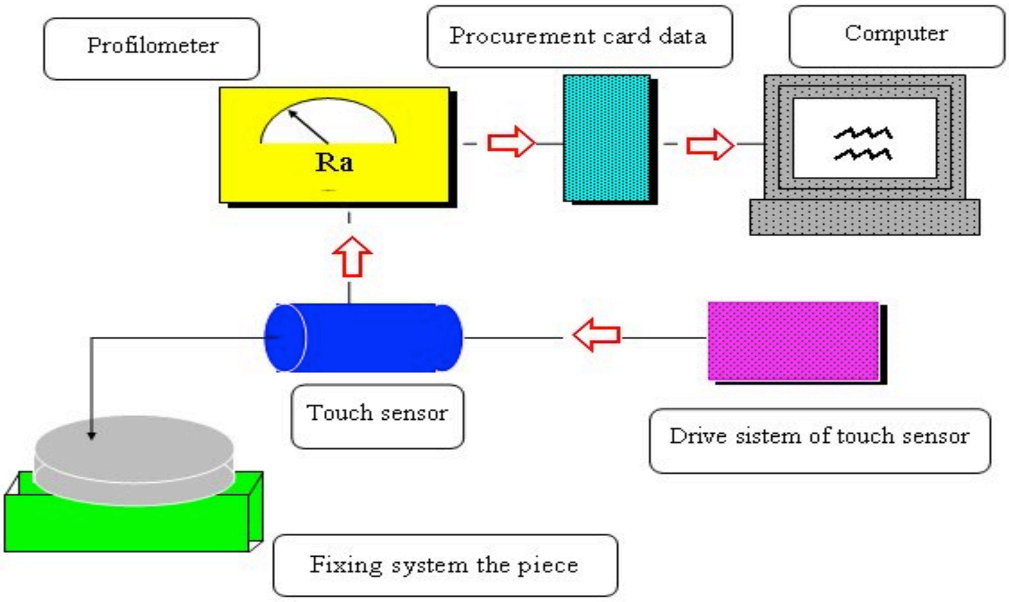

Figure 1. Schematic diagram of the general experimental stand

Table 1. Matrix-program to productivity modeling

Nr. crt.	Coded values (physicals) of the factors in influence				Roughness, R_a [μm]
	X_{F1}	X_{F2}	X_{F3}	X_{F4}	
1	-1 (355)	-1 (20)	-1 (1,6)	-1 (6)	1,48
2	+1 (900)	-1 (20)	-1 (1,6)	-1 (6)	1,34
3	-1 (355)	+1 (100)	-1 (1,6)	-1 (6)	1,42
4	+1 (900)	+1 (100)	-1 (1,6)	-1 (6)	1,18
5	-1 (355)	-1 (20)	+1 (12,5)	-1 (6)	8,24
6	+1 (900)	-1 (20)	+1 (12,5)	-1 (6)	7,26
7	-1 (355)	+1 (100)	+1 (12,5)	-1 (6)	5,16
8	+1 (900)	+1 (100)	+1 (12,5)	-1 (6)	4,44
9	-1 (355)	-1 (20)	-1 (1,6)	+1 (35)	1,54
10	+1 (900)	-1 (20)	-1 (1,6)	+1 (35)	1,48
11	-1 (355)	+1 (100)	-1 (1,6)	+1 (35)	1,46
12	+1 (900)	+1 (100)	-1 (1,6)	+1 (35)	1,38
13	-1 (355)	-1 (20)	+1 (12,5)	+1 (35)	8,42
14	+1 (900)	-1 (20)	+1 (12,5)	+1 (35)	6,28
15	-1 (355)	+1 (100)	+1 (12,5)	+1 (35)	7,46
16	+1 (900)	+1 (100)	+1 (12,5)	+1 (35)	5,84
17	-2 (82,5)	0 (60)	0 (7,05)	0 (20,5)	4,54
18	+2 (1172.5)	0 (60)	0 (7,05)	0 (20,5)	3,26
19	0 (627.5)	-1,2 (12)	0 (7,05)	0 (20,5)	2,08
20	0 (627.5)	+2 (140)	0 (7,05)	0 (20,5)	1,98
21	0 (627.5)	0 (60)	-1,2 (0,4)	0 (20,5)	0,38
22	0 (627.5)	0 (60)	+2 (18)	0 (20,5)	8,42
23	0 (627.5)	0 (60)	0 (7,05)	-1,2 (3,1)	2,78
24	0 (627.5)	0 (60)	0 (7,05)	+2 (49,5)	4,38
25	0 (627.5)	0 (60)	0 (7,05)	0 (20,5)	0,60
26	0 (627.5)	0 (60)	0 (7,05)	0 (20,5)	0,58

- Import and convert them into files with extension "xls" EXCEL specific, by using the Text Import Wizard;

- Allocation of the columns maintaining the independent variable (time) and the dependent (millivolts) and remove all other columns adjacent to registration;

- Establishing the minimum value for the dependent variable and the translation to this, all other values in the positive domain;

- Establishing the arithmetic mean deviation of the dependent variable;

- Equivalence arithmetic mean obtained for each sample. Arithmetical average of the standard with Ra=6.1 μm;

- Conversion values (in millivolts) in micrometers dependent variable for assessing surface roughness recorded;

- Conversion values (expressed in milliseconds) the independent variable in units of length profile that was registered;

- Determine the new abscissa corresponding to the average line profile;

- Profilogram drawing for each sample.

For the two parts corresponding point of the experiment (last two lines of Table 1) were made profilograms for five reference lengths [2] and Figures 2, presents profilograms for a single length.

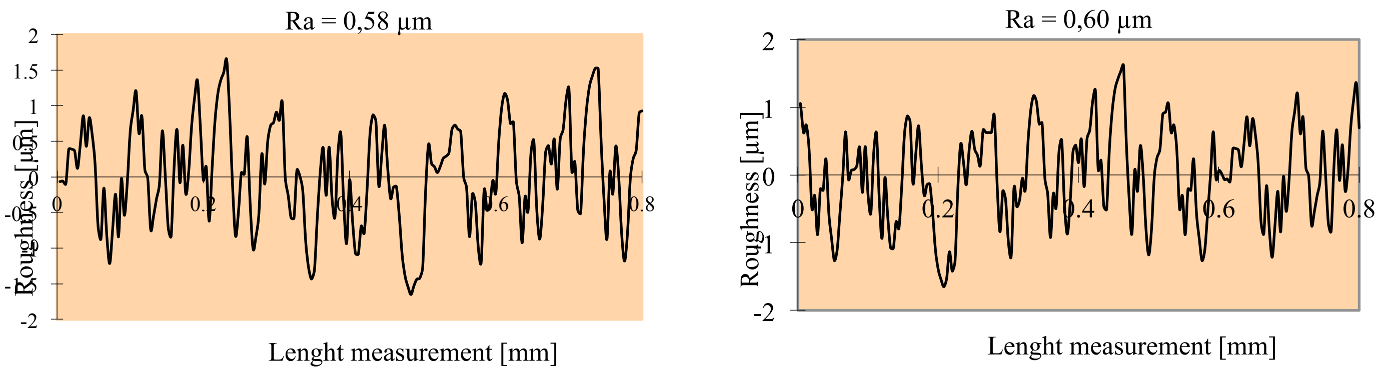

Figure 2. Profilograms with a reference length for the two workpieces

4. ANALYSIS OF LIKELIHOOD ESTIMATORS OF ROUGHNESS MAIN

In practice mathematical processing of experimental data on the geometrical surface, its random characteristics are associated with a function key. Analytical form of the profile studied can be highlighted by the spectral density function; autocorrelation function and lift curve ABBOTT - FIRESTONE [1], [5].

Research undertaken to date, believes that roughness is a random variable with a normal distribution law (Gauss) for most technological processes with exponential law and Rayleigh law for some special procedures. For this purpose these are oriented researching, aimed for identifying suitable probability distribution of the processed magneto-abrasive surface. Acquired data at the roughness measuring and on which they were drawn the profilograms presentes primary data to define spectral density functions, autocorrelation functions and lift curves ABBOTT - FIRESTONE.

Processing of results was greatly facilitated by the use of high-performance software, including software and STATGRAPHICS. Files with the extension "xls" files were converted to type 'Text Tab Delimited "which STAGRAPHICS program recognizes and can import them. For the two samples analyzed using procedures "Distribution Fitting" family of distribution functions and "Autocorrelation Function" Temporal analysis of frequency histograms (figure 3) and autocorrelation functions (figure 4) were made. Verifying normality of data distribution was performed using the procedure "Summary Statistics" family descriptive methods of the same program, and χ^2 test applications. Table 2 presents statistical parameters characterizing the roughness distribution of the two samples analyzed. Using Excel, using data acquired roughness measurement system of lift curves were drawn for each of the two parts analyzed [3], [4] before and after treatment and the comparation is presented in Figure 5, the final curves the original

Workpiece roughness of 0,58 µm **Workpiece roughness of 0,60 µm**

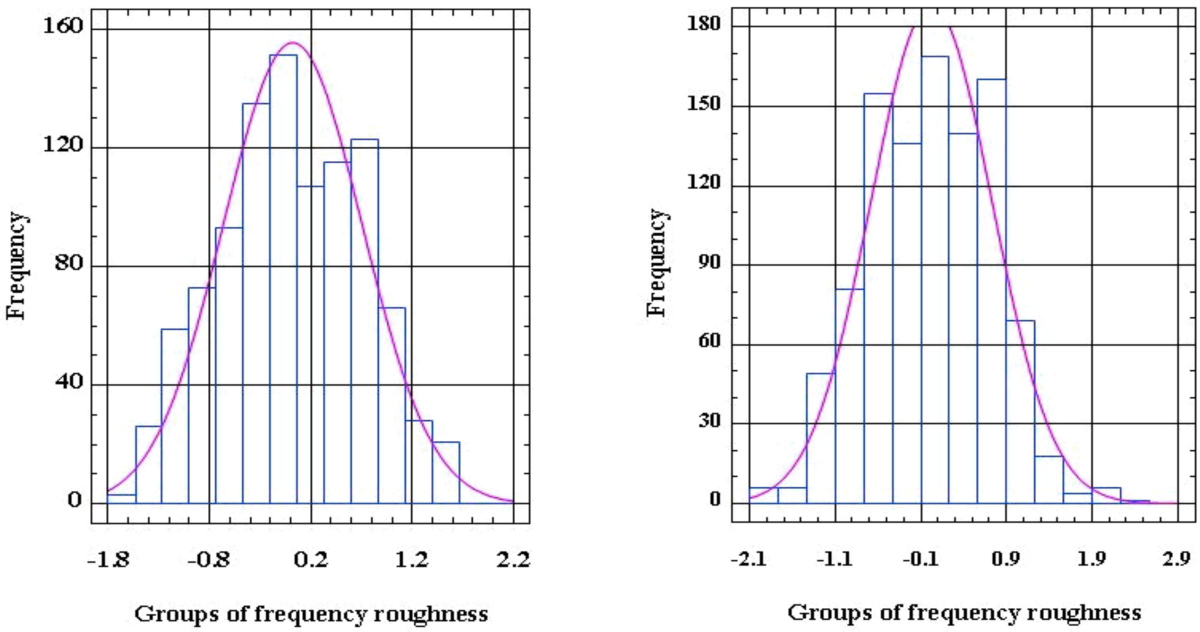

Figure 3. Frequency histograms for the two workpieces

Workpiece roughness of 0,58 µm Workpiece roughness of 0,60 µm

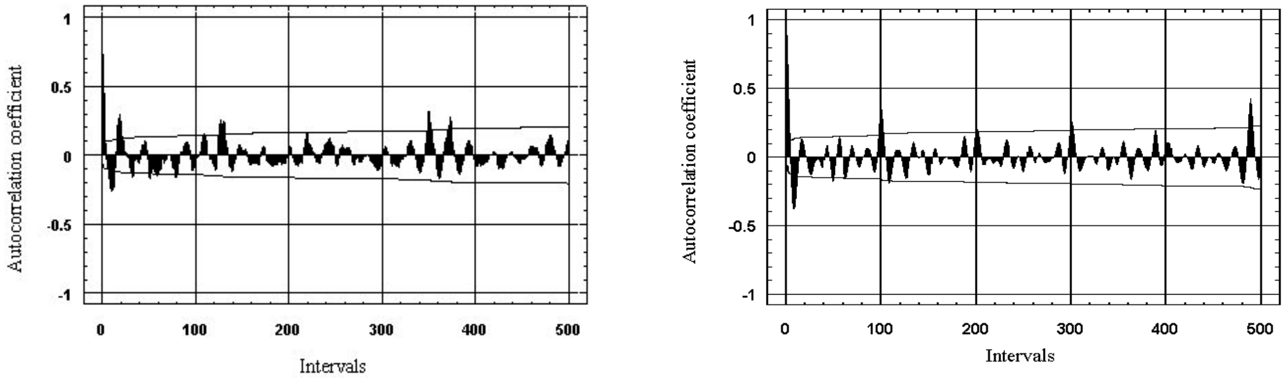

Figure 4. Autoccorelation functions chart

Table 2. Checking normality distribution

Parameter	Sample 1 (R_a=0,58 µm)	Sample 2 (R_a=0,60 µm)
- Coefficient of asymmetry	- 0,074	0,01
- Coefficient of excess	- 0,498	- 0,299
Arithmetic mean	0,022	0,024
Median	0	0
Standard deviation	0,684	0,706
Empirical dispersion	0,468	0,498
χ^2_{calc} test	60,83/ 11 degrees of freedom	51,7/ 9 degrees of freedom

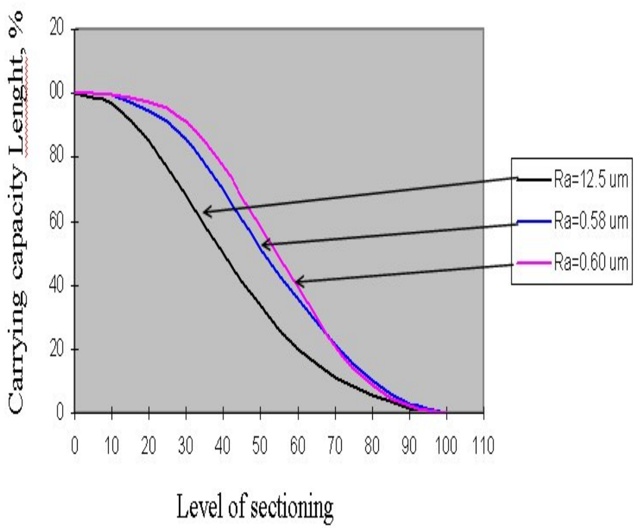

Figure 5. Comparative carrying capacity curves

5. CONCLUSIONS

Processing of the acquired data to measure roughness allows the following conclusions:
- Density distribution analysis for surface roughness obtained from the processing of magneto-abrasive has a form that tends to be a normal Gaussian distribution (see figure 3), this is supported by the excess coefficient values slightly negative, insignificant, and the coefficients insignificant asymmetry (tab.2). All this shows that random roughness vector satisfies the central limit theorem of statistical and mathematical theory. In addition, the tendency towards normal Gaussian distribution with processing magneto-abrasives placed the processing in the family of cutting technology machining processes [2], [5];

- Autocorrelation coefficients are toward lower confidence interval bounded by twice the standard error, which indicates that there is no systematic trend of the process, including frequency and hence roughness is governed solely by random phenomena. Without any tendency of the process proves its stability, homogeneity and isotropy obtained from processing areas;

- Equipment and software used allowed the establishing of the maximum real estimator of roughness, which is the lift curve [2]; allure of these curves tend asymptotically to lines limiting profile and there is a single point of inflection indicates the similarity of these curves that the ideal (Abbott-Firestone). All these findings allows to attribute a stability of the magneto-abrasives machining processes and the obtained surfaces, isotropy and homogeneity.

6. REFERENCES

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