RESEARCH

UDK 621.9.015.004.7

S. SEKULIĆ

Correlation Between Some Roughness Parameterst of the Machined Surface in Finish Turning

The relationship between individual roughness parameters of a machined surface is approximately given by tables. In order to determine more accurate relationships between maximal roughness height and mean aruthmetic deviation of the profile from mean line, experimental results were processed for statistically valid sample N=78>50 and pointed strong correlation between roughness parameters.

Keywords: *roughness parameters, finish turning*

1. INTRODUCTION

Relationship between particular parameters of roughness is given very often in simplified form independent of kind of process and work piece material, and another conditions which follow the process.

For example, relationship between the maximum roughness height and arithmetic deviation of the profile from the mean line, i.e. their numerical values, is given in a table (German standard DIN 4767/70) and relationship of the mean height in ten points and the arithmetic deviation of the profile from the mean line according to Yugoslav standard JUS M.A1.020/79, with a remark on its approximation.

Relationship between maximum height of roughness and the average arithmetic deviation of the profile from the mean line $R_{max} = f(R_a)$, in exponential for

$$R_{max} = 6,1595\, R_a^{0,98}$$

is given independent on the condition which follows the *process*. However, that the exponentin the last equation is approximately one, it can be concluded that, between the maximum height of roughness and average arithmetic deviation of profile, there is a proportionality , i.e.

$$R_{max} \triangleq 6,16 = R_a$$

Professor Sava St. Sekulic, Ph.D.
Faculty of Technical Science
University of Novi Sad
Yugoslavia

The correlation between maximal roughness height and mean arithmetic deviation of the profile from the mean line and bearing ratio and mean arthmetic deviation of the profile from the mean line of machined surface in finish turning for a statistically valid sample, in exponential

$$R_{max} = B\, R_a^{\,a} \quad \text{and} \quad p_n = B\, R_a^{\,a}$$

and linear form

$$R_{max} = a\, R_a + b \quad \text{and} \quad p_n = a\, R_a + b$$

have been requested in this paper.

2. EXPERIMENTAL INVESTIGATION

2.1 The influential parameters of the machined surface roughness

The approaches to the investigation of the roughness can be divided into three groups: 1. geometrical models, 2. the models based on the tool wear and the other supporting influences, 3. models based on the response surface methodology.

The geometrical and experimental models for cutting with the sharp tool were investigated by: Schmaltz (1936), Opitz and Moll (1940), Galloway (1945),Beleckiy (1946), Skragan (1947), Takenaka (1951), Krivouhov (1958), Bramertz (1961), Olsen (1968) / 4 /, Solaja (1952-1972), Sekulic (1970), Fischer (1971).

The influence of the groove wear and other parameters on the roughness of the surface was investigated by: Galloway (1945), Akinaci (1949), Pekelharing and Schuennan (1953), Thompson, Schatt and Stabler (1953/54), Solaja (1957-1972), Bramertz (1961), Sekulic (1962), Pekelharing and Giesen (1967-1971), Selvam and Radhakrishnan (1973 and 1971), Snunmugam (1974), Lonardo(1976), Bailey (1977), Wallbank (1979), Monheim (1981).

The statistical approaches to the determination of the dependence of the surface roughness based on response surface methodology were developed by Rasch (1971), Kuljanic (1971), Taraman (1974-1977), Nassirpour and Wu (1977), Miskovic (1978), Sekulic and Kovac (1979), Kovac (1980), Kovac and Sekulic (1981).

2.2 Mathematical model of correlation

In order to determine correlation relationship between the bearing ratio and maximal roughness hright of the machined surface, the voluminous experimental material on two types of construction steels in finish turning were performed in exponential form

$$Y = B \cdot X^n$$

and in linear form

$$y = ax + b$$

2.3 The environment of the experiments and statistical data processing

The material of the work piece was: 1. constructional steel C.0645 (JUS) (DIN St60). According to JUS standard, the chemical composition is provided as follows: 0,43% C; 0,29% Si; 0,79% Mn; 0,015% P and 0,001% S, and mechanical characteristics: tensile strength of material σ_M = 740 N/mm^2, yield strength σ_V = 360 N/mm^2 and elongation δ_5 = 17%.

2. constructional steel for the improvement C.4732 (JUS) (DIN 22CrMo4). Chemical composition: 0,42% C; 0,27% Si; 0,63% Mn, 11% Cr, 0,16 Mo, 0,12% P and 0,010% S. Mechanical characteristics: tensile strength of m aterial σ_M = 680 N/mm^2

The experiments were performed on universal lathe " Potisje - Morando " PA21, motor power 10 kW and number of spindle revolutions from 20 to 2000 rev/min.

As a cutting tool the cutter for finish turning JUS K. C1. 052 / 65 (ISO 3), holder cross sectional area 12x20 mm^2, with insert A10 (JUS K. C1. 006), back rake angle γ = 12° and noes radius r = 0,5 ; 0,9 and 1,6 mm was used.

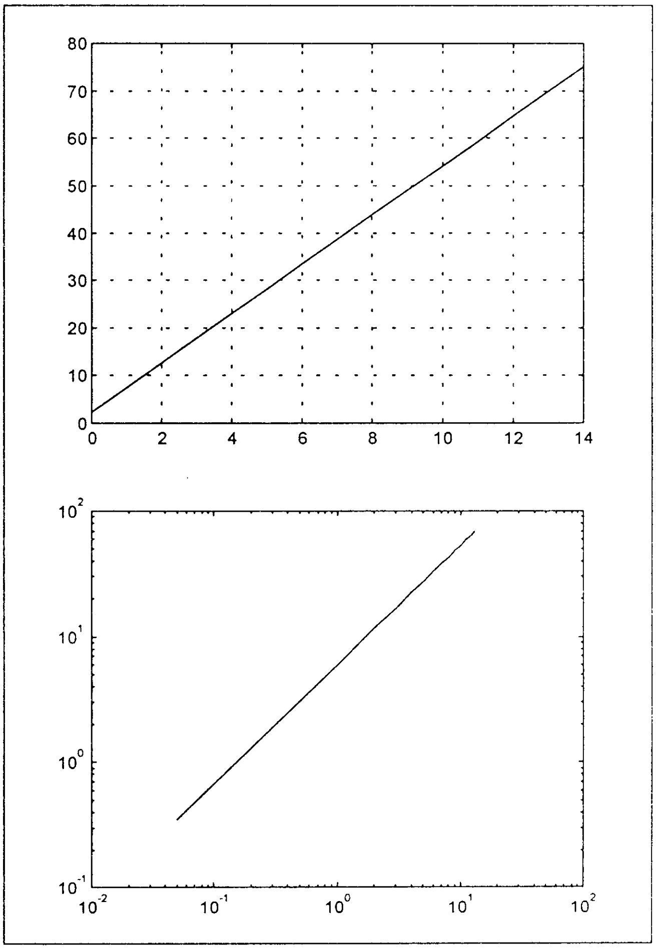
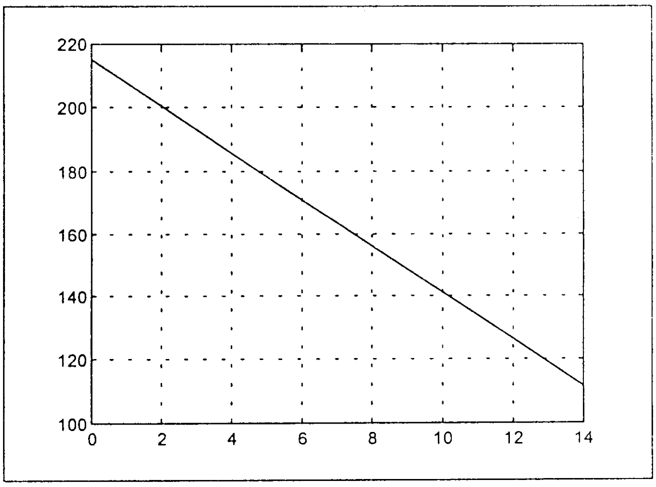


Figure 1. The mean atithmetic roughness versus maximal roughness R_{max} in mathematical models $R_a = BR_{max}^{\ a}$ and $R_a = aR_{max} + b$

The roughness parameters were measured using the Perth-0-Meter, type "Universal".

For the purpose of giving providing enough reliable relationships between variable values, for both of investigate materials, the statistically valid samples of N = 78 > 50, are taken.



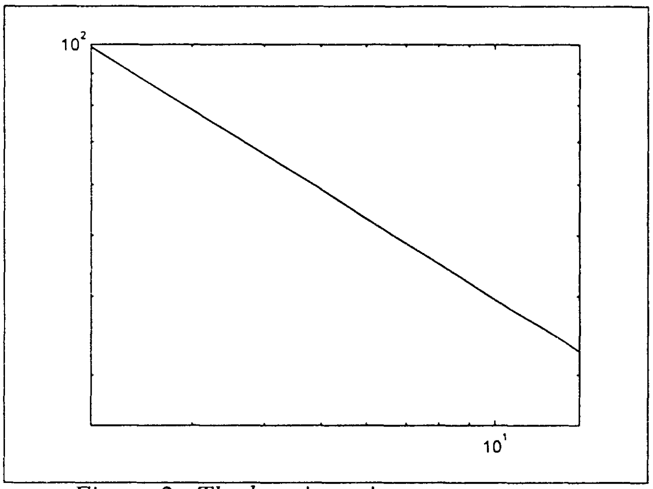


Figure 2. The bearig ratio p_n versus mean arithmetic roughness R_a in mathematical models $p_n = B R_a^a$ and $p_n = a R_a + b$

The graphical presentations of the maximal roughness height R_{max} *and mean* aarithmetical deviation of profile from the mean line R_a for two investigated materials are given in the figure Fig. 1.

The numerical data processing the next regresional equations, are given:

$R_{max} = 6{,}01\ R_a^{0{,}95}$ (r = 0,94)	$p_n = 147{,}25\ R_a^{-0.57}$ (r =0,93)
$R_{max}= 5{,}20R_a + 2{,}24$ (r = 0,88)	$p_n = -7{,}39\ R_a + 215{,}22$ (r = 0,93)

3. ANALYSIS OF RESULTS

After experimental data processing, convenient mathematical models are evaluated by the coefficient of correlation value and on the basis of the magnitude of exponents in the exponential relationships.

However, if the exponent in exponential relationship is near one, the linear relationship between variables exist. In exponential relationship, if the value of exponent is not near one, the linear relationship can be generally ignored.

In accordance with the presented we can generally conclude that, for all proposed models, corresponding coefficient of correlation are sufficiently high (r > 0,88).

The numerical values of exponents in relationship $R_{max} = B\ R_a^{\ a}$ *is* a = 0,95 , which points small deviation from linear relationship, however, and in linear mathematical model $R_{max} = a\ R_a + b$ height coeficient of correlations are given, to.In relationships $p_n = B\ R_a^{\ a}$ is a = -0,57 , which point large deviation ftom linear relationship, but the coefficient of correlation is hight.

4. CONCLUSIONS

Referring to the above mentioned, we conclude:

- for mathematical models of correlation which connected maximal roughness height of the machined surface and mean arithmetical deviation of profile from mean line in finish turning, the exponential and linear relationships can be used,
- for investigated materials, in proposed mathematical models, egzist strong correlation between the observed parameters.

REFERENCES

[1.] *Djachenko, P.E. and al..*, **0 razrobotke proekta medzunarodnogo standarda na sherohovatost poverhnosti, Kachestvo poverhnosti detelej mashin**, Trudi seminara po kachestvu poverhnosti, Sbornik 4, Izdatelstvo AN SSSR, Moskva, 1959.

[2.] *Sekulic, S., Kovac, P.*, **Korelacija izmedju najvece visine neravnina i srednjeg aritmetickog odstupanja profila od srednje linije obradjene povrsine pri zavrsnoj obradi na strugu**, Tribologija u industriji, god. VIII, br, 1. 1986.

[3.] *Sekulic, S , Kovac, P.*, **Korelacija medzi jednotlivymi parametrami drsnosti obrobeho povrchu prijemnom sustruzeni**, Prednasky 3. Sympozium INTERTRIBO '87, I. diel, April. 27, 1987, Vysoke Tatry, 1987.

[4.] *Sekulic, S., Kovac, P.*, **Korelacija izmedju procenta nosenja i srednjeg aritnetickog odstupanja profila od srednje linije obradjene povrsine pri zavrsnoj obradi na strugu**, Proc. Int. Conf. on Advanced Manufact. Systems and Technology, AMST '87, Opatija, 1987.

[5.] *Sekulic, S., Kovac, P.*, **Korelacija izmedju pojedinih parametara hrapavosti obradjene povrsine pri zavrsnoj obradi na strugu**, Tribologija u industriji, god. XV, br.4, pp 145 - 150., 1993.

[6.] *Sekuic, S., Kovac, P.*, **Correlation Between Bearing Ratio and Mean Arithmetic Deviation of the profile from the Mean Line of Mchined Surface in Finish turning**, Proc. of 2nd International Conference on Tribology - BALKANTRIB 96, June 1996, Thesaloniki, Greece, pp 289 - 294. 1996.