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ALGORITHM FOR PREDICTING THE ROUGHNESS OF THE INNER SURFACE DURING TURNING PROCESS

The article analyzes the main technological factors affecting the quality of parts, specifically the quality of the treated surface or the roughness of the surface of the part. Turning (boring) was considered as an example, and a number of measures aimed at improving the quality of the surface at the design stage were also proposed. A simulation stochastic model of surface roughness shaping during surface turning was proposed. Based on this model, an algorithm and a computer program were developed to calculate the roughness at the design stage. The initial data for modeling are the main angle in the plan φ, the auxiliary angle in the plan φ1, the radius at the tip of the cutter r and the feed S, as factors that most strongly affect the roughness during boring. An experiment was carried out, where not only average values were obtained, but also histograms of the distribution of roughness parameters, the adequacy of this model was proved. When calculating the roughness, additional factors were taken into account, for example, the condition of the machine, which made it possible to correct the simulation stochastic model and introduce vibration components associated with the forces acting during cutting and elastic squeezes of the cutter during boring process.

Keywords: turning processing, surface quality, surface roughness, imitating model, stochastic model.

Introduction

The quality provision of detail surface with technological methods usually comes down to the processing technology, choice of the metal-cutting calculation of processing which can provide demanded parameters with the smallest expenses. Forecasting of processed surface quality of the detail on the projecting stage is an actual task as it allows minimizing probability of defecting products, to optimize cutting conditions, to avoid defect products and with these essentially to save means.

A host of reasons influence on the surface roughness formation: properties of detail material, condition and parameters of the machine, cutting tool, its geometry, processing type etc. And the forecast of the possible surface roughness after processing is carried out, as a rule, on the basis of mathematical modeling which being in any case only approximate to real process of the form building at boring, nevertheless, allows to receive very large volume of information and often can even be more exact than real model that allows to replace with it expensive experiments. However, not all mathematical models as they are often heavy and difficult, are suitable for practical application, aspiring to cover as the bigger quantity of influencing elements is possible and to receive fuller information [1–4]. And here it is especially possible to note stochastic models allowing to consider casual parameterization on the basis of which it is possible to define not only demanded average output values of roughness parameters (in our case), but also to receive their vibration and accumulated distribution [5,6].

Materials and methods

The height of roughness (or height match mark of the micro profile of the processed surface) is closely connected with geometry of the cutter and some parameters of cutting modes and is increased at great values of S, φ, φ_1 and $r_в$ value reduction, and on the contrary. In reality, random factors influence on formation of the surface micro profile [7–9].

When turning, which includes boring; four main types of drawings are formed on the treated surface [10].

The initial data for modeling are the main angle in the plan φ, the auxiliary angle in the plan φ_1, the radius at the tip of the cutter r and the feed S. Calculations by the formulas of roughness are quite labor-intensive therefore it is possible to use roughness calculations by means of numerical algorithms in the Excel program where match mark profile is in the form of tabular data presented. The height of such received profile thus any more will not be identical and integration is conducted within base length l. Thus it simplifies calculation, actually being imitating model of the form building microprofile of the processed surface and gives the open space for further modernization of the program by means of introduction of additional factors (random factors) influencing on the process of roughness formation. Proceeding from principles of stochastic modeling on initial parameters overlay influence of random factors; it is in particular fluctuations of tool parameters of the main angle in the plan φ, an auxiliary angle in the plan φ_1, radius at top r. The normal law of distribution which was accepted is most suitable for a large number of influencing factors (1):

$$\begin{cases} f(\varphi) = \dfrac{1}{\sqrt{2\pi\sigma_1}} \exp\left(-\dfrac{(\varphi - \overline{\varphi})^2}{2\sigma_\varphi^2}\right) \\ f(\varphi_1) = \dfrac{1}{\sqrt{2\pi\sigma_2}} \exp\left(-\dfrac{(\varphi_1 - \overline{\varphi_1})^2}{2\sigma_1^2}\right) \\ f(r) = \dfrac{1}{\sqrt{2\pi\sigma_r}} \exp\left(-\dfrac{(r - \overline{r})^2}{2\sigma_r^2}\right) \end{cases} \qquad (1)$$

All distributions parameters are defined according to the rule of three sigma (2):

$$\overline{\varphi} = \frac{\varphi_{max} + \varphi_{min}}{2}; \quad \overline{\varphi_1} = \frac{\varphi_{1max} + \varphi_{1min}}{2}; \quad \overline{r} = \frac{r_{max} + r_{min}}{2};$$
$$\sigma_{\varphi} = \frac{\varphi_{max} - \varphi_{min}}{6}; \sigma_{\varphi 1} = \frac{\varphi_{1max} - \varphi_{1min}}{6}; \sigma_r = \frac{r_{max} - r_{min}}{6}; \quad (2)$$

Thus, there is the determined model with a certain set of initial parameters on the basis of imitating stochastic model:

Initial parameters for calculation are:

– Maximum and minimum of the main angle in the plan φ;

– Maximum and minimum of auxiliary angle in the plan φ_1;

– Maximum and minimum of the radius at the cutter top r;

– Maximum and minimum of cutting depth t;

– Feeding S;

The algorithm of imitating stochastic modeling was made on the basis of the data.

According to algorithm after input of basic data there is generation of casual variability of data j, j_1, r, set number of calculations N (it is recommended not less than 100). On the well known restrictions (to r> 0 or r=0, values φ, φ_1) is chosen match mark option after which match mark junction points are calculated on formulas and its profile is calculated, too. After match mark profile calculation there is its processing, and the program can calculate average values of roughness, their disorder and receive curve distribution density of each from parameters, in our case values R_{acp}, R_{amax}, Ramin and curves of the distribution range R_a.

Taking into account all given above restrictions and on the basis of stochastic imitating model the program for modeling of roughness formation was created at boring of the internal surface, allowing at introduction of cutting parameters to predict numerical profile parameters of the processed surface, in particular distribution of Ra, Racp and some others. Modeling allows to reduce time and in many respects to reduce expenses on researches.

Results and discussion

Carrying out of adequacy estimation of model of stochastic imitating modeling and offered on the basis of algorithm of the computer program «Calculation of laws of parameters distribution of roughness at turning» is possible experimentally. The imitating stochastic model is created for turning processing of internal surface, it was allocated operation-internal surface turning 2, (Ø70, 5/Ø71,5)

Output data for modeling and experiment:

– type of processing – internal turning;

– the equipment – screw cutting lathe;

– fixing in the three-jaw self-centering chuck Ø315 mm;

– cutting tool – a cutter turning boring, tool section 25x25, total length L=200 mm; tool overhang l=70 mm;

– Geometry of cutting tool-main angle in the plan φ = 60^0, auxiliary angle in the plan φ1=300, Radius at cutter top r=0,2;

– Geometry pointing errors of the tool before processing: j = 60±$2,5^0$, φ1=30^0±$2,5^0$, φ= $0,2^{+0,2}$ mm.

– Cutting modes- feeding S=0,09¼¼/min., depth of cutting on the side t=0,5 mm, spindle turns at cutting n = 630 t/min.;

– Material of processed detail-steel 30.

Processing of the batch of work pieces, all twelve, with the subsequent measurement of roughness of internal processed surface on profile meter was made.

Figure 1 – Production run of the processed details

During experiment after processing of each preparation the cutter was taken away and fixed again to the cutter holder of the machine for creation of setting error on the anglej. Three cutters with soldered plates from hard alloy metal T15K6 are used for approaching to real production; cutter change after processing of each feedstock, i.e. each cutter processed four feedstock.

After processing details on the machine with identical cutting modes were made measurements of twelve samples with usage of the profile meter Surftest SJ-210 the producer the firm Mitutoyo (Japan), profilogram was taken from each sample. Data of measurements are entered in table 1.

Table 1 – Values of obtained at measurement roughness parameters Ra

No. sample	Ra (μm)	No. sample	Ra (μm)
1	1,710	7	1,690
2	1,634	8	1,524
3	1,577	9	1,451
4	1,533	10	1,449
5	1,689	11	1,780
6	1,507	12	1,733

The modeling of surface roughness formation for boring at these modes of cutting with application of geometrical parameters used at processing tool was made after carrying out the experiment. The imitating stochastic model and computer program developed on its basis «Calculation of laws of distribution parameters of roughness at boring» was applied to modeling.

At modeling processing conditions similar to our carried out experiment, it is necessary to consider equipment condition, namely screw cutting lathe 16K20 (Production Russia). The machine condition at visual survey is estimated as satisfactory, however the presence of vibrations when processing which will have certainly consequences for roughness formation of the surface which we should consider in the course of program The imitating stochastic model has to be corrected for calculation of vibrating component at roughness calculation and to make changes in it connected with forces operating at cutting and elastic cutting pressing at boring.

The calculation of cutting force at boring [7]:

$$P_z = 10C_p t^x S^y V^n K_p \tag{3}$$

According to the reference C_P = 300, K_P=1,55, x = 1, y = 0,75, n = -0,15.

From data on processing cutting modes: t= 0,5 mm, S = 0,09 mm / run, n = 630 run/min., D =71,5mm.

From where $V = \frac{\pi Dn}{1000}$ = 141 m/min. P_Z = 178 N.

Elastic pressing can be calculated:

Flexural deformation of the cutter under the influence of cutting force:

$$\Delta z = P_z / C \tag{4}$$

Where, C– rigidity of technological system (N/mm).

Rigidity of the cantilevered beam:

$$C = \frac{3EJ}{L^3} \tag{5}$$

where E-elasticity module (for steel E=2,1 ·10^{11} n/m^2); L – tool overhang (L = 0,07 m); J– inertia moment of cutter section (cutter 25x25mm).

$$J = \frac{ab^3}{12} = 3{,}255*10^{-8}\ m^4$$

Having substituted the obtained data in the formula (5) for rigidity calculation, we will receive C=5,98 104 N/mm.

Substituting Pz and C in the formula (4) we receive elastic pressing $\Delta z \approx 3$ microns.The vibrating component of roughness is developed from making roughness from geometrical copying:

$$h_2 = \frac{h_2'\omega^2}{\omega^2 - \lambda^2}, \tag{6}$$

where ω – frequency of free vibrations; λ – frequency of forced vibrations.

For calculation of frequency of free vibrations it is necessary to calculate the specified weight.

$$m = \frac{\rho \cdot a \cdot b}{f_0^2} \int_0^L \left[\frac{Lx^2}{6EJ} \left(3 - \frac{x}{L} \right) \right]^2 dx = 0{,}038\,kg, \qquad (7)$$

Where ρ = 7850 kg/m³ – steel density; f_0 = 1/C -maximum ratio of deflection.

Then frequency of free vibrations is equal to: $\omega = \sqrt{C/m} = 39700$ Hz

Frequency of forced vibrations is defined with run out details and frequency of its rotation: λ= 2n/60 π= 66 Hz.

Because of the fact forced frequency on some orders are less than free, h2 = h2' = 0, 2 · Δ z= 0,6 microns. Actually it means that distribution of values of roughness parameter will move towards increase at 0,6 microns.

After correction of the program, we enter known output data into the program for profile calculation of surfaces (fig. 2), further casual values of geometrical corners of cutter in the prescribed limits were generated, the profile match mark is calculated and expected values Racp, distribution Ra and range of distribution parameter Ra (fig. 3) are received.

The distributions range (fig. 3) characterizes roughness variation and reasons of this variation: geometry errors of the tool and vibration.

	input parameters				additional options	
	Geometric parameters		Cutting modes		angle of rotation ω	0
	φmin=	57,5	n=	630	Angle step	12
	φmax=	62,5	S=	0,09	Number of risks	1
	φ1min=	27,5	d=	71,5	Pitch along axis	0
	φ1max=	32,5	V=	2,358550685	number of sheets	200
Calculation	rmin=	0,2	K=	0		
	rmax=	0,4		141,5130411		

Calculation results										
the actual geometry of the cutting edge										
	1	2	3	4	5	6	7	8	9	10
φ=	60,95677	60,26307679	59,94349299	59,1934748	59,42964171	58,48185351	59,15058	59,24341	60,64355	59,84228
φ1=	29,8222	29,65898606	31,09626447	29,0700809	30,67102462	31,58245413	30,271084	30,58991	29,00462	29,55972
r=	0,324871	0,248597238	0,235471806	0,26289908	0,322774102	0,307183247	0,3215193	0,343975	0,301328	0,290758
h=	0,003132	0,004106775	0,004339871	0,00387992	0,003152262	0,003313954	0,0031647	0,002956	0,003379	0,003503
Topographic parameters										
Ra=	0,018144	0,018143594	0,018143594	0,01814359	0,018143594	0,018143594	0,0181436	0,018144	0,018144	0,018144
Sres	0,079267	0,079267131	0,079267131	0,07926713	0,079267131	0,079267131	0,0792671	0,079267	0,079267	0,079267
L	1,135629	1,135629445	1,135629445	1,13562945	1,135629445	1,135629445	1,1356294	1,135629	1,135629	1,135629

Figure 2 – Output data (screenshot) entered into the program for calculation

Note: Actually geometry of the cutter received by generation of their casual values in prescribed limits was defined in 200 options.

The distribution density is submitted to the normal law (check on criterion χ2) with parameters Racp = 1,488 microns, σRa = 0,105 microns, these data are received as a result of calculation more than 200 roughness values for different cutters on the program.

Where parameter σRa is standard deviation or dispersion in the sampling population.

$$\sigma_{Ra} = \sqrt{\frac{\sum \left(Ra_i - Ra_{cp} \right)^2}{n-1}} \qquad (8)$$

On the rule of three sigma for normal law

Rasr-3ra σ<Ra <Racp+3Raσ:

1,173 ≤Ra≤ 1.803 microns.

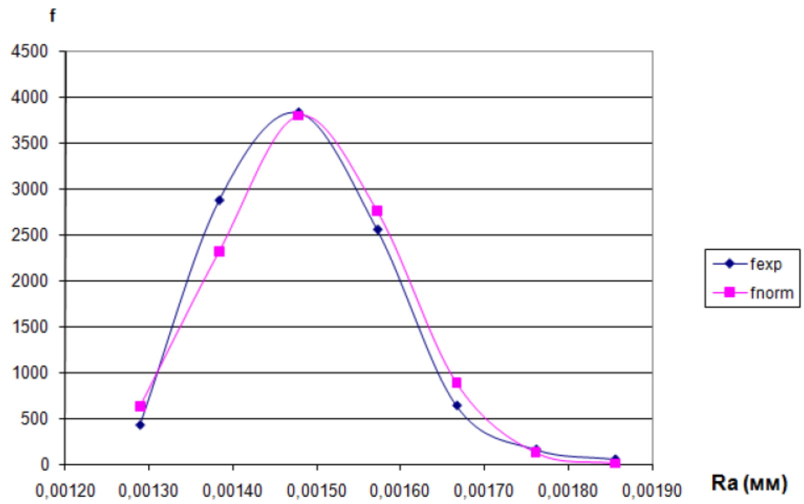

Figure 3 – Distribution range of the parameter Ra (mm) taking into account shift on vibration

Experimental data are kept within this range of the theoretical variation of roughness received by us that also confirms adequacy of model.

Conclusion

1 A simulation stochastic model of roughness formation during turning of internal surfaces is proposed, taking into account various processing parameters, such as tool geometry, tool vibrations, parameters of cutting modes;

2 A program has been created to calculate the laws of distribution of roughness parameters during boring of the inner surface, theoretical data on the roughness spread have been obtained and its convergence with experimental data has been proved, which shows the adequacy of the computer program.

3 Received results allow approving that the imitating stochastic model of roughness formation is adequate to real process at internal surface boring and allows receiving not only average values, but also histograms of distribution of roughness parameters.

4 This also gives the chance to forecast roughness of the processed surface at projecting stage and correspondingly to select necessary cutting tools, equipments and cutting modes for achievement of necessary roughness.

REFERENCES

1 **Shayakhmetov, Y., Mendebaev, T., Manezhanov, B., Temirtasov, O., Ibragimova, R., Abilmazhinov, Y.** Prediction of development prospects of roller support designs for conveyor systems // International Journal of Applied Engineering Research. – 2015. – № 17. – P. 38110–38115. – https//doi.org/10.1109/IDAACS.2017.8095040.

2 **Manezhanov, B., Temirtasov, O., Shayakhmetov, Y., Shaikhanova, A., Abilmazhinov, Y., Mansurov, S.** Prospective design of conveyor rollers // Research Journal of Applied Sciences. – 2016. – № 5. – P. 197–201. – https//doi.org/10.3923/rjasci.2016.197.201.

3 **Kulinowski, P., Kasza, P., Zarzycki, J.** Influence of Design Parameters of Idler Bearing Units on the Energy Consumption of a Belt Conveyor // Sustainability. – 2021. – № 13 (1). – P. 437–450. – https//doi.org/10.3390/su13010437.

4 **Shayakhmetov, Y., Manesanov, B., Dildebaeva, Z., Shaikhanova, A., Kochan, R., Zawislak, S.** The loading computation algorithm on bearings of rollers of belt conveyor // Proceedings of the 2017 IEEE 9th International Conference on Intelligent Data Acquisition and Advanced Computing Systems : Technology and Applications. – 2017. – № 2. – P. 584–589. – https//doi.org/10.1109/IDAACS.2017.8095040.

5 **Denkena, B., Dittrich, M., Huuk, J.** Simulation-based surface roughness modelling in end milling // Paper presented at the Procedia CIRP. – 2021. – № 99. – P. 151–156. – https//doi.org/10.1016/j.procir.2021.03.096.

6 **Voronov, S. A., Kiselev, I. A., Voronova, I. S.** A stochastic model of plane grinding dynamic for the texture formation analysis // Vibroengineering Procedia –2021. – P. 185–192. – https//doi.org/10.21595/vp.2021.22096.

7 **Суслов, А. Г., Шалыгин, М. Г., Кузнецов, С. В.** Исследование поверхностей с различной механической обработкой на уровне субшероховатости // Наукоёмкие технологии в машиностроении. – 2015. – № 9. – С. 45–47.

8 **Deepanraj, B.** Investigation and Optimization of Machining Parameters Influence on Surface Roughness in Turning AISI 4340 Steel // FME Transactions. –2020. – № 2. – P. 383–390. – https//doi.org/10.5937/FME2002383B.

9 **Verma, V., Kumar, J., Singh, A.** Optimization of Material Removal Rate and Surface Roughness in Turning of 316 Steel by using Full Factorial Method // Materials Today. –2019., – № 25. – P. 793–798. – https//doi.org/10.1016/j.matpr.2019.09.029.

10 **Serebrennikova, A. G., Savilov, A. V.** A Study of Effects of the Cutting Tool Geometry on the Output Parameters when Turning VT22 Titanium Alloy // Proceedings of the 7th International Conference on Industrial Engineering. – 2021. – P. 642–649. – https//doi.org/10.1007/978-3-030-85230-6_76.

REFERENCES

1 **Shayakhmetov, Y., Mendebaev, T., Manezhanov, B., Temirtasov, O., Ibragimova, R., Abilmazhinov, Y.** Prediction of development prospects of roller support designs for conveyor systems // International Journal of Applied Engineering Research. – 2015. – № 17. – P. 38110–38115. – https//doi.org/10.1109/IDAACS.2017.8095040.

2 **Manezhanov, B., Temirtasov, O., Shayakhmetov, Y., Shaikhanova, A., Abilmazhinov, Y., Mansurov, S.** Prospective design of conveyor rollers // Research Journal of Applied Sciences. – 2016. – № 5. – P. 197–201. – https//doi.org/10.3923/rjasci.2016.197.201.

3 **Kulinowski, P., Kasza, P., Zarzycki, J.** Influence of Design Parameters of Idler Bearing Units on the Energy Consumption of a Belt Conveyor // Sustainability. – 2021. – №13 (1). – P. 437–450. – https//doi.org/10.3390/su13010437.

4 **Shayakhmetov, Y., Manesanov, B., Dildebaeva, Z., Shaikhanova, A., Kochan, R., Zawislak, S.** The loading computation algorithm on bearings of rollers of belt conveyor. Proceedings of the 2017 IEEE 9th International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications. – 2017. – № 2. – P. 584–589. – https//doi.org/10.1109/IDAACS.2017.8095040.

5 Denkena, B., Dittrich, M., Huuk, J. Simulation-based surface roughness modelling in end milling // Paper presented at the Procedia CIRP. – 2021. – № 99. – P. 151–156. – https//doi.org/10.1016/j.procir.2021.03.096.

6 **Voronov, S. A., Kiselev, I. A., Voronova, I. S.** A stochastic model of plane grinding dynamic for the texture formation analysis // Vibroengineering Procedia –2021. – P. 185–192. – https//doi.org/10.21595/vp.2021.22096.

7 **Suslov, A. G., Shaly`gin, M. G., Kuzneczov, S. V.** Issledovanie poverxnostej s razlichnoj mexanicheskoj obrabotkoj na urovne [Study of surfaces with various mechanical treatments at the sub-roughness level] // Science-intensive technologies in mechanical engineering. – 2015. – № 9. – P. 45–47.

8 **Deepanraj, B.** Investigation and Optimization of Machining Parameters Influence on Surface Roughness in Turning AISI 4340 Steel // FME Transactions. –2020. – № 2. – P. 383–390. – https//doi.org/10.5937/FME2002383B.

9 **Verma, V., Kumar, J., Singh, A.** Optimization of Material Removal Rate and Surface Roughness in Turning of 316 Steel by using Full Factorial Method // Materials Today. –2019., – № 25. – P. 793–798. https//doi.org/10.1016/j.matpr.2019.09.029.

10 **Serebrennikova, A. G., Savilov, A. V.** A Study of Effects of the Cutting Tool Geometry on the Output Parameters when Turning VT22 Titanium Alloy // Proceedings of the 7th International Conference on Industrial Engineering. – 2021. – P. 642–649. – https//doi.org/10.1007/978-3-030-85230-6_76.

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ТОКАРЛЫҚ ӨҢДЕУ КЕЗІНДЕ ІШКІ БЕТТІҢ КЕДІР-БҰДЫРЫН БОЛЖАУ АЛГОРИТМІ

Мақалада бөлшектердің сапасына, атап айтқанда, өңделген беттің сапасына немесе бөлік бетінің кедір-бұдырына әсер ететін негізгі технологиялық факторларға талдау жасалады. Мысал ретінде токарлық өңдеу (жонып өңдеу) қарастырылды, сонымен қатар жобалау кезеңінде бет сапасын жақсартуға бағытталған бірқатар шаралар ұсынылды. Токарлық өңдеу кезінде беттің кедір-бұдырлығының пайда болуының имитациялық стохастикалық моделі ұсынылды. Осы модель негізінде, жобалау кезеңінде кедір-бұдырлықты есептеу үшін алгоритм мен компьютерлік бағдарлама жасалды. Модельдеудегі бастапқы деректері, жонып өңдеу кезінде кедір-бұдырлыққа ең көп әсер ететін факторлар ретінде, пландағы негізгі бұрыш φ, пландағы көмекші бұрыш φ1, кескіштің жоғарғы жағындағы радиус r және азықтандыру S болып табылады. Эксперимент жүргізілді, онда тек орташа мәндер ғана емес, сонымен қатар кедір-бұдырлық параметрлерінің таралу гистограммалары алынды, оған қоса, бұл модельдің сәйкестігі дәлелденді. Кедір-бұдырды есептеу кезінде қосымша факторлар ескерілді, мысалы, машинаның күйі, бұл Имитациялық стохастикалық модельді түзетуге және кесу кезінде әсер ететін күштермен және кесу кезінде кескішті серпімді қысумен байланысты діріл компоненттерін енгізуге мүмкіндік берді.

Кілтті сөздер: токарлық өңдеу, беттің сапасы, беттің кедір-бұдырлығы, имитациялық модель, стохастикалық модель.

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АЛГОРИТМ ПРОГНОЗИРОВАНИЯ ШЕРОХОВАТОСТИ ВНУТРЕННИХ ПОВЕРХНОСТЕЙ ПРИ ТОКАРНОЙ ОБРАБОТКЕ

В статье проведен анализ основных технологических факторов, влияющих на качество деталей, а конкретно на качество обработанной поверхности или шероховатость поверхности детали. В качестве примера была рассмотрена токарная обработка (растачивание), а также предложен ряд мер, направленных на повышение качества поверхности еще на этапе проектирования. Была предложена имитационная стохастическая модель формообразования шероховатости поверхности при токарной обработке поверхности. На основе этой модели был разработан алгоритм и компьютерная программа для расчета шероховатости на этапе проектирования. Исходными данными при моделировании являются главный угол в плане φ, вспомогательный угол в плане φ_1, радиус при вершине резца r и подачу S, как факторы наиболее сильно влияющие на шероховатость при растачивании. Проведен эксперимент, где были получены не только средние значения, но и гистограммы распределения параметров шероховатости, доказана адекватность данной модели. При проведении расчета шероховатости были учтены дополнительные факторы, например состояние станка, что позволило скорректировать имитационную стохастическую модель и внести вибрационные составляющие, связанную с силами, действующими при резании и упругими отжатиями резца при растачивании.

Ключевые слова: токарная обработка, качество поверхности, шероховатость поверхности, имитационная модель, стохастическая модель.

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