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Optimization of machining parameters during the steel work-pieces turning

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Abstract— One of the mostly used processes in the manufacturing machine parts, is turning process. The parameters of this process have different effects on the machining capabilities. So one of the problems associated with this process is the optimal choice of parameters to achieve the most optimal machining capabilities. In traditional machining, machining parameters are determined based on the data included in the Handbook, person or programmer's experience, and implemented changes during machining such as tool wear or changes in work piece dimensions have no effect on these parameters. This reduces the effectivity of the machining process. The aim of this study is to simulate an intelligent system to evaluate the optimal machining parameters. In this research using experimental design method the effect of main input data of machining process such as cutting speed, depth of cut, feed rate and tool tip radius on the surface roughness changes have been studied. First, based on the data obtained data from empirical experiments in machining the fitness function has designed and modelled, then using genetic algorithms technique, the optimization variables of machining for improving work-piece surface finish were determined.
Keywords— Optimal Choice, Work Piece, Genetic Algorithms, Machining Process

I. INTRODUCTION

Today, in advanced manufacturing and producing processes the production of high quality and low cost parts is important. Machining operations on work-pieces are some of the most effective factors in the final price of the products. Therefore, the final price of a product can be reduced by decreasing the machining costs by optimizing the conditions and appropriate setting of the variable parameters in machining operations. Many parameters effect the turning process, if used in optimal conditions, in addition to reducing the cost, they will increase the quality, too. Selection of optimal cutting parameters such as cutting depth, feed rate and cutting speed is an important issue in any machining process [1]. Improving cutting parameters is not easy and requires knowledge of machining and knowing the empirical relationships between cutting variables such as forces, production amount, machined surface finish quality, and the knowledge of mathematical optimization. To optimize a machining process many factors can be considered into account that depend on the operation kind and machining conditions. It should be noted that the optimization of machining operations is an issue where there is contrast between different subjects. For example, reducing feed rate and cutting speed will lead to an increase in tool life, however, it will decrease cutting rate at the same time. Also, increase in feed rate will reduce machining time, but may not create the desired surface roughness. Therefore, in order for optimizing and determining the optimum machining parameters, it is necessary to consider some restrictions such as minimum and maximum cutting speed and feed rate, maximum tool life, the quality of surface roughness, maximum force for machining, the maximum temperature for the tool's tip. Some restrictions depend on the machine tools and some depend on the quality of surface and some on metallurgical properties of the work-piece, and the cutting tool whose threshold amounts should be determined before optimization. The quantity of the above-mentioned limitations should be measured using either different appropriate sensors mentioned previously, experimental-Analytical models.

In 2000, Meng and colleagues introduced a method for calculating the optimum cutting conditions based on factors such as minimum cost and maximum production time [2]. The Taylor equation is used In the process of optimizing a reformed form, and the equation constants have been determined using machining operation.

In 2005, Bouzid offered a mathematical model to calculate the optimal cutting conditions, to reduce the time of production to least possible amount in the process of high-speed turning [3]. The machine power and the main axial maximum speed are considered as process limitations. Based on this model cutting speed that leads to lowest production time is calculated.

In 2006, Cus and his colleague optimized the cutting condition using artificial neural networks. Their purpose of optimization is to minimize production time, reduce production costs and improve surface quality [4]. They have also considered technological, economic and organizational limitations in optimization.

Therefore, according to the mentioned information, achieving optimal quality by selecting the maximum amount of the cutting

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parameters can be more economical. In this study, using professional knowledge base, an algorithm has been provided on machining parameters during the process of machining which carries out the smart selection of machining parameters to achieve desired quality according to the presented information. The depth of cut, work-piece material and surface finish are considered as the input, and the cutting speed and feed as the output. Finally, a software is prepared to do this work and presented results are favourable.

II. TESTING EQUIPMENT

In this study, experiments were performed with lathe machine made in Mashin-Sazi Tabriz Company. The lathe machine has that can be equipped with multiple tools. Figure 1 shows a used lathe machine.

Fig.1 Lath machine MASHIN-SAZI

In this study, In order to apply cooling mode a lubricant consists of cutting fluid and Z-ONE solvent is used. The Time - TR200 Surface Roughness Tester device and Ra criteria were used In order to measure the machined surface roughness. Figure 2 shows the Surface Roughness Tester device used in this study.

Fig.2 TR200 Surface Roughness Tester

For measuring the tool wear a 1000x zoom microscope from Jenus Company was used. Figure 3 shows the used microscope.

Fig.3 JENUS 1000x zoom microscope

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To carry out the tests of turning processes the cutting process, some steel work-pieces with a diameter of 25 mm were prepared and tested. Figure 4 shows an image of this work-piece.

Fig.4 work-Piece

In this research, in order for machining the work-piece of a high-speed steel tool is used. This tool is characterized by TNMG2204. Figure 5 shows the image the tool used in this study.

Fig.5 TNMG2204 tool used in this study

III. EXPERIMENTS DESIGN

The experiments design is in fact a method of simultaneous study of several variables in a process. Experiment design utilizes geometric principles in such a way that the required statistical data are chosen to create a model and appropriate analysis of the model. The right choice means that the amount of required data for analysis will be minimized and designing points distribution will be more homogeneous [5]. To fit a response surface modelling, experiment's designing points is a very important factor in efficiency and accuracy of the created model. In general, the design of experiments points can be performed in different ways. In experimental design method, first experiments are designed in such a way that as well as investigating the effects of each parameter, the effects of interactions between parameters are also studied. Using this method requires numerous mathematical calculations and operation. Especially when the number of process variables is large. In this study, to create an experiment design to conduct the required empirical experiments Taguchi method has been used. For this reason, the variation range of examined data was defined according to Table 1. For every input variable three levels have been definition and the required experiment design conducted on the basis of Table 2.

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TABLE I

FACTORS IN EXPERIMENTAL DESIGN

NO	The input variables	Minimum	Maximum
1	cutting speed (m/mm)	60	180
2	depth of cut (mm)	0.5	1.5
3	feed rate (mm/rev)	0.08	0.24
4	tool tip radius (mm)	0.8	1.2

TABLE 2

TAGUCHI EXPERIMENTAL DESIGN METHOD CREATED

NO	cutting speed	depth of cut	feed rate	tool tip radius
1	60	0.5	0.08	0.8
2	60	0.5	0.16	1
3	60	0.5	0.24	1.2
4	60	1	0.08	1
5	60	1	0.16	0.8
6	60	1	0.24	1.2
7	60	1.5	0.08	0.8
8	60	1.5	0.16	1.2
9	60	1.5	0.24	1
10	120	0.5	0.08	0.8
11	120	0.5	0.16	1
12	120	0.5	0.24	1.2
13	120	1	0.08	1
14	120	1	0.16	0.8
15	120	1	0.24	1.2
16	120	1.5	0.08	0.8
17	120	1.5	0.16	1.2
18	120	1.5	0.24	1
19	180	0.5	0.08	0.8
20	180	0.5	0.16	1
21	180	0.5	0.24	1.2
22	180	1	0.08	1
23	180	1	0.16	0.8
24	180	1	0.24	1.2
25	180	1.5	0.08	0.8
26	180	1.5	0.16	1.2
27	180	1.5	0.24	1

IV. CREATING BEHAVIOURAL MODEL PROCESS USING RESPONSE SURFACE METHOD

Response surface method is a series of methods of experiments design, mathematical techniques and statistical inference that can predict the behavioural model and analyse a multivariate system. In other word, the response surface method is a statistical method that take the acquired numerical data from empirical experiments and based on mathematical-statistical interactions offers a multivariate equation according to the system's input data [6]. The model created by response surface method is, in fact, a model created by approximation. Based on the degree defined for a model, an equation with the least possible error determines approximate range of input data. In the approximate range of input data invalid. The precision of created model depends on the approximation equation degree and the number of inputs. The more the equation degree is and the more obtained empirical data is, the model developed by response surface method will be more reliable. In this study to create a model after analysing practical mathematical-statistical models based on the utilized experimental design, a base model radius 7 with 17 central points which compared the least possible amount of square root error with other models has been chosen as the behavioural model of the process regarding the degree of surface roughness. Table 3 illustrates the comparison of experimental results with data generated by the model.

TABLE 3
COMPARISON OF EXPERIMENTAL RESULTS WITH MODEL ANSWERS

NO	Ra	Predicted
1	2.04	2.0
2	1.72	1.68
3	1.83	1.9
4	1.06	1.04
5	2.3	2.32
6	2.03	1.97
7	2.1	2.05
8	1.6	1.5
9	1.62	1.58
10	1.42	1.3
11	1.89	1.76
12	2.05	2.12
13	2.12	2.08
14	1.82	1.82
15	1.16	1.12
16	1.04	0.98
17	2.0	1.94
18	1.63	1.58
19	2.32	2.3
20	2.3	2.24
21	1.12	1.08
22	1.62	1.82
23	1.53	1.65
24	2.01	2.12
25	1.78	1.82
26	1.92	1.84
27	2.32	2.35

V. CONCLUSIONS

In this project, to calculate the optimum cutting conditions in machining operations the required programming has been done using MATLAB software. The programs are based on a mathematical model that have been mentioned. In every program the required inputs entered according to appropriate units and the type of turning operation (surface cutting or facing), and then the desired outputs are printed. Outputs include cutting speed, the speed of the main axis, tool life, machining time, and average production costs per work-piece in minimum time and production cost condition. In facing operation due to variability of cutting speed it won't be printed. Using the programs is quite easy and optimal cutting conditions can be achieved in a short time. In this paper, the programs algorithm is described. The research results summarized as follow:

A. The results showed that increased cutting speed, feed rate, and decreased load depth will lead to the lowest surface roughness.

B. The results showed that low cutting speed, feed rate and low load depth will lead to minimum wear.

C. The results showed that cutting speed and feed rate have the greatest impact on surface roughness and wear.

REFERENCES

[1] Wang, J., Kuriyagawa, T., Wei, X. P., Guo, D. M., "Optimization of cutting conditions for single pass turning operations using a deterministic approach International", Journal of Machine Tools and Manufacture, Vol. 42, Issue 9, , pp. 1023-1033, July 2002.

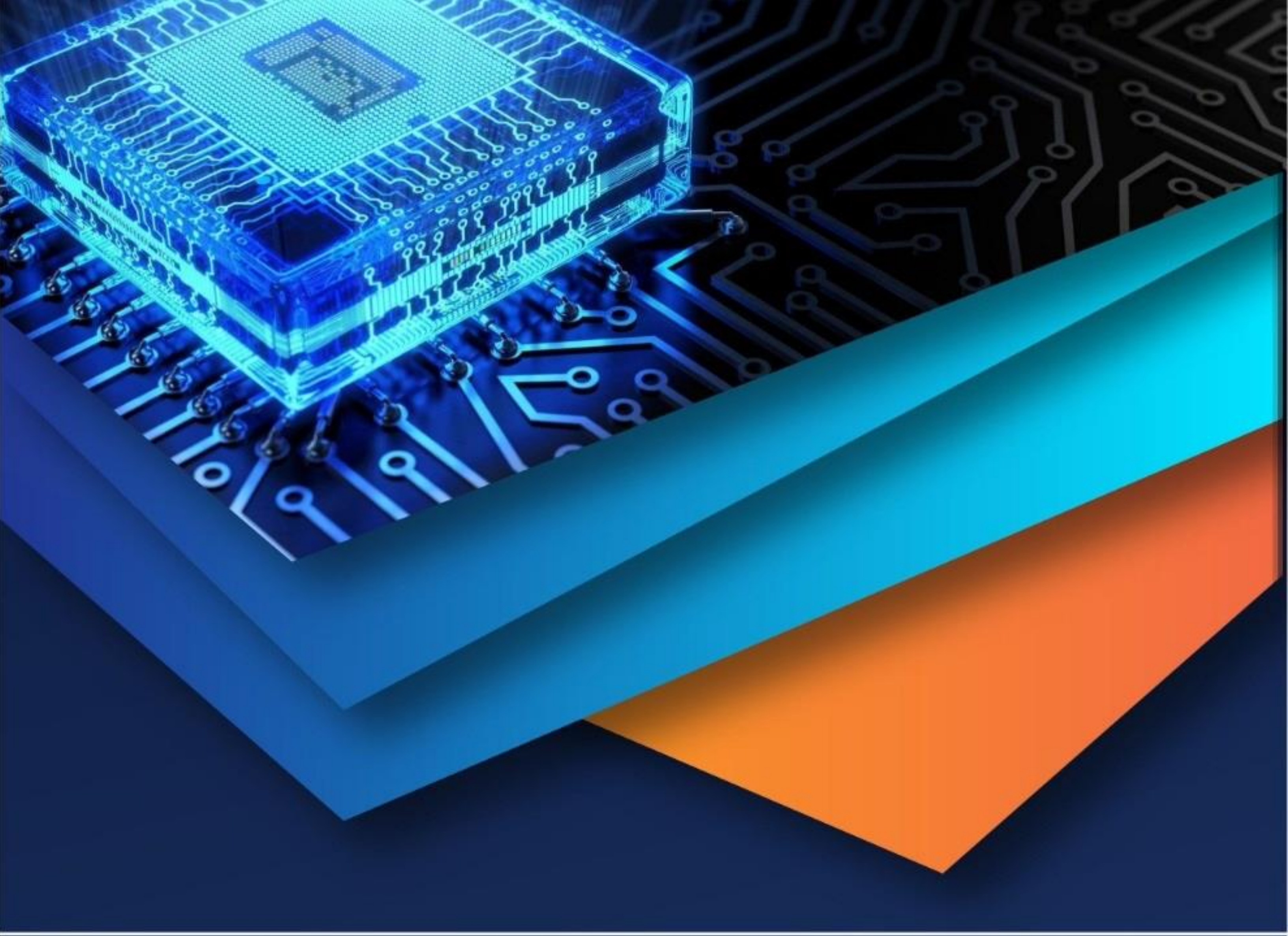
[2] Meng, Q., Arsecularatne, J. A., Mathew, P., "Calculation of optimum cutting conditions for turning operations using a machining theory", International Journal of Machine Tools and Manufacture, Vol. 40, Issue 12, pp. 1709-1733, September 2000.ag,

[3] Wassila Bouzid, "Cutting parameter optimization to minimize production time in high speed turning", Journal of Materials Processing Technology, Vol. 161, Issue 3, pp. 388-395, 30 April 2005.

[4] Franci Cus, Uros Zuperl, "Approach to optimization of cutting conditions by using artificial neural networks", Journal of Materials Processing Technology, Vol. 173, Issue 3, pp. 281-290, 20 April 2006.

[5] Yi-Chi Wang, "A note on 'optimization of multi-pass turning operations using ant colony system", International Journal of Machine Tools and Manufacture, Vol. 47, Issues 12-13, pp. 2057-2059, October 2007.

[6] Fang, XD, safi-jahanshaki, H, 1997. A new algorithm for developing a reference model for predicting surface roughness in finish machining of steels. International journal of production research 35, 179-197otorola,



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