Modeling and Thermal Control of Elastic Abrasive Cutting Process

Anna Stoynova, Irina Aleksandrova, and Anatoliy Aleksandrov

***Abstract*—**The paper considers the results from the application of a thermography approach to the analysis of heat fluxes and the determination of the temperature of the work piece, cut-off wheel and cut piece in elastic abrasive cutting. The thermal distribution upon changing the cut-off wheel diameter, compression force and workpiece rotation frequency has been investigated for different materials by means of an infrared camera. The complex effect of the conditions of elastic abrasive cutting on the cut-off wheel, cut piece and workpiece has been modelled by using the multiple regression analysis method. The optimal conditions ensuring minimal values for temperature parameters have been defined by applying multi-objective optimization and a genetic algorithm. The achieved results could be used for thermal control and appear a precondition for increasing tool durability, process intensity and the quality of surfaces being processed.

***Keywords*—**Elastic abrasive cutting, Thermography approach, Modeling, Multi-objective optimization, Thermal control.

I. Introduction

Abrasive cutting is a high performance method for producing workpieces from rods up to 60÷70 mm in diameter by means of cut-off wheels of an up to 400 mm diameter at a 4 mm cut-out width. During the process a large amount of heat is released. It enters the workpiece (Φ_w), cut-off wheel (Φ_s), and chip (Φ_{ch}) and radiates into the ambience (Φ_p) [1]–[4]. A wide-range variations of the heat flux components has been identified: $\Phi_w = (10\% \div 65\%)\Phi$; $\Phi_s = (3\% \div 20\%)\Phi$ $\Phi_{ch} = (30\% \div 60\%)\Phi$; $\Phi_p \approx 10\%\Phi$ [2], [4]–[8] depending on the selected design of process implementation, cut-off wheel response and cutting mode. That presumes different temperatures of the cut-off wheel working and side surfaces, as well as different workpiece and chip temperatures.

An increase in the heat entering the cut-off wheel leads to higher tool wear and lower cutting intensity as a result of a decrease of the relative compression of the abrasive grains on the surface being processed. Heating of the workpiece in the cutting zone causes changes in the surface material microstructure and occurrence of thermal defects. In addition, structural changes in the cut cross-section (chips, imperfections, material deformation) requiring follow-up processing are caused by smoothing and splitting of cut-off wheel parts, as well as by the friction between the cut-off wheel side surfaces and the workpiece front surfaces [2], [8]-[10]. In this respect, temperature plays a vital role in abrasive cutting for cut-off wheel operability and processed surface quality. Therefore, it should be studied, modeled and optimized.

Thermal control provides good conditions for enhancing tool durability, cutting process intensity and quality of surfaces being processed. That could be achieved by changing the abrasive cutting conditions (cutting design, cutting mode parameters, cut-off wheel response, properties of the material being processed) which directly determine the thickness of the layer being cut and the temperature of the tool, chip, workpiece and cut piece.

Thermal phenomena in hard abrasive cutting have thoroughly been researched [6], [11]–[13]. The design of elastic abrasive cutting is of particular interest (Fig. 1) since it ensures constant area of the instantaneous cross-section of the layer being cut thus stabilizing the dynamic and thermal phenomena involved in the cutting process [14]–[16].

Within the design the cut-off wheel performs two motions: a main rotary motion at speed V_s and a radial feed motion at speed V_{fp} in relation to a turning workpiece. Tool radial feed is implemented by exerting a constant compression force on the workpiece ($F = \text{const}$), where $V_{fp} \neq \text{const}$.

The test results from the elastic abrasive cutting of turning

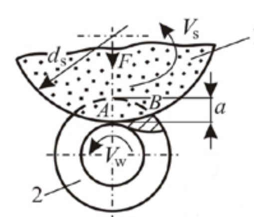

Fig. 1 schematic diagrams of elastic abrasive cutting
1 - cut-off wheel; 2 – workpiece

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rotational workpieces show that the heat flux components and the temperature of the tool, chip, workpiece and cut piece depend on the contact area between the cut-off wheel and the workpiece whose dimensions are determined by the magnitude of the compression force F, workpiece rotational frequency n_w and cut-off wheel diameter d_s [17]–[19]. It has been established that chip temperature and cut piece temperature decrease with a decrease in the cutting rate and an increase in the workpiece rotational frequency. This effect is related to the enhanced heat extraction as a result of the higher thickness of the layer being cut, the larger cross-section of the chip being cut by one abrasive grain and the cutting time.

Thermal phenomena in elastic abrasive cutting of stationary workpieces of various diameters have also been studied by Kaczmarek [6], [20]. He has found that the cut-off wheel compression force exerted on the workpieces has the greatest impact on the maximum cut-off wheel temperature, respectively on tool durability. If it is increased to 72 daN, temperature rises. If the force is further increased to 82 daN, temperature drops. It has been established that temperature rises if workpiece diameter is increased.

The temperature measurement approach to be used depends on the specific nature of cutting processes [10], [21]–[23]. With abrasive cutting measurement is difficult to implement because of the small dimensions of the zone being heated (only tenths of mm^2), high temperatures (hundreds of degrees Celsius), high temperature gradient (more than $200^oC/mm^2$), high mechanical loading and high heating rate. Hence contactless temperature measurement methods should be applied, such as infrared thermography (IRT), which is increasingly used as a reliable and effective tool for contactless observation, and for determining the quality under real cutting conditions [22], [24].

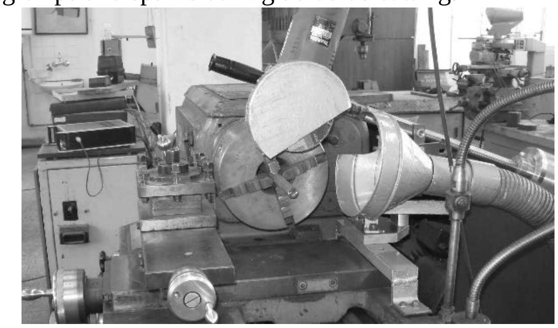
The paper aims to study thermal phenomena in elastic abrasive cutting by applying IRT and designed experiments so as to 1) build models reflecting the complex influence of the cut-off wheel diameter d_s, compression force F and workpiece rotational frequency n_w on the temperature of the cut-off wheel, workpiece and cut piece for different materials being processed; 2) define the optimal conditions for the process implementation.

II. Experimental Study and Modelling of Temperature

A. Equipment, materials and methods

The purpose of this study is to find the correlations between the maximum temperature of the workpiece T_w, the maximum temperature of the cut-off wheel T_s, the temperature of the cut piece T_d and the operating conditions during the elastic abrasive cutting. In this respect, cut-off wheel diameter d_s, compression force F and workpiece rotational frequency n_w have been chosen as control factors.

To perform the elastic abrasive cutting process (Fig. 1) a special attachment has been designed (Fig. 2 [16]). It has been fixed to the main carriage of a combination lathe, supplied with a device for stepless adjustment of workpiece rotational frequency n_w. The attachment comprises an angle grinder which ensures constant rotational frequency of the cut-off wheel ($n_s = 8500\ \mathrm{min}^{-1}$), and a unit for adjusting the amount of compression force F of the cut-off wheel to the workpiece. An aspirator system is included to arrest, collect and remove the flying chips and sparks during abrasive cutting.



Fig, 2 Workstand for elastic abrasive cutting

Experimental studies have been conducted during counter-directional cutting with cut-off wheels 41-180x22.2x3.0 A30RBF (EN 12413: 2007). The material being processed is in the form of cylindrical rods of a diameter $d_w = 30$ mm, steels C45 (1.0503) and 42Cr4 (1.7045) – BS EN 10277-2:2015 (Table I).

The general form of the models describing the relationship between the studied parameters (maximum temperature of the workpiece, maximum temperature of the cut-off wheel and temperature of the cut piece) and the group of independent variables: factors d_s (x_1), F (x_2) and n_w (x_3), is:

$$y_g = b_0 + \sum_{i=1}^{3} b_i x_i + \sum_{i=1}^{3} b_{ii} x_i^2 + \sum_{i<j}\sum b_{ij} x_i x_j \quad (1)$$

where: $g = 1-6$; $y_1 = T_{w,C45}$, $y_2 = T_{s,C45}$, $y_3 = T_{d,C45}$, $y_4 = T_{w,42Cr4}$, $y_5 = T_{s,42Cr4}$, $y_6 = T_{d,42Cr4}$.

Table I Chemical composition and physico-mechanical properties of steels being studied

Steel, type	Chemical composition			σ_B (MPa)	HB
	C (%)	Mn (%)	Cr (%)		
C45 (1.0503)	0.44	0.5	0.2	750	192
42Cr4 (1.7045)	0.4	0.5	1	1000	205

The form of the model has been chosen on the basis of the theoretical and experimental studies of the influence of the elastic abrasive cutting conditions on temperature by taking into account the non-linear character of experimental dependencies $T_w = f(n_w)$, $T_s = f(n_w)$ and $T_d = f(n_w)$ [17]–[19].

To build the theoretical and experimental models (1), multi-factor experiments have been conducted by using an orthogonal central-composition design. The number of experiments is $N = 2^n + 2n + 1 = 15$ ($n = 3$ is the number of control factors).

Three observations have been made for each experiment. The variation limits of control factors are presented in Table II. They are determined on the basis of preliminary experimental studies of the performance of abrasive cut-off wheels [16], [25], [26], as well as on the distribution of the heat fluxes in the workpiece, chip, cut-off wheel and cut piece in the course of the elastic abrasive cutting process [17]–[19].

Table II Factor levels in the experimental design

Factors		Factor levels		
		-1	0	+1
x_1	d_s (mm)	120	150	180
x_2	F (daN)	1	2	3
x_3	n_w (min^{-1})	22	91	160

The models have been built by measuring the values of the workpiece maximum instantaneous temperature, cut-off wheel maximum contact temperature and cut piece temperature at the end of the cut-off cycle.

Measurements have been carried out by an infrared camera ThermaCam SC640, operating in the spectral range of 7.5 μm to 13 μm with image resolution 640 x 480 pixels and IP-link using FireWire. It has a temperature range of -40 ºC to +2000 ºC with accuracy of reading ± 2%. ThermaCAM Researcher Pro 2.9 software package is used for real-time monitoring and temperature measurements. Further processing of thermograms is performed in MATHLAB [19]. The IR camera has been calibrated and the region of interest (ROI) has been chosen to be on the cutting area. Measurements have been carried out in two positions: in the direction of cutting and in a direction perpendicular to the direction of cutting. Each measurement is performed three times.

The methods for measuring temperature and processing measurement results are thoroughly described in [19]. Measurements are preceded by defining the emissivity of the cut-off wheels and the two steel types. Emissivity is measured by means of a heated chamber furnaces and soot used as a coating of a known emission coefficient. The temperature dependence of the obtained emission coefficients are used for software correction. The difference in the temperatures of the cutting zone and the surface temperature of the accessible surface has been estimated at 15% for the steel samples. Fig. 3 shows the thermograms at the end of the cutting process, recorded for two positions: a view to the cut-off wheel and workpiece (on the left) and a side view of the cut-off wheel (on the right) when d_s =180 mm, $n_s = 8500$ min^{-1}, n_w = 22 min^{-1}.

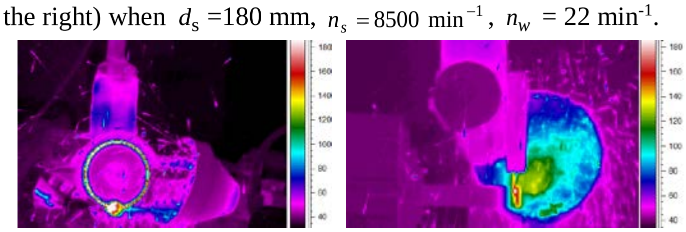
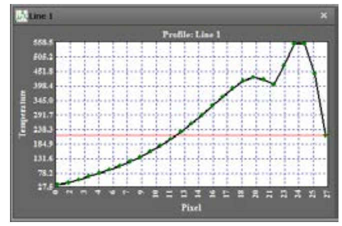
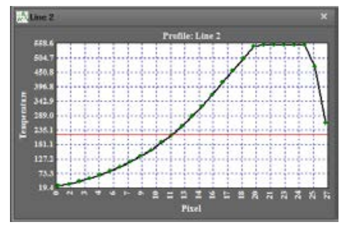


Fig. 3 Sample thermograms at the end of the elastic abrasive cutting process of steel C45

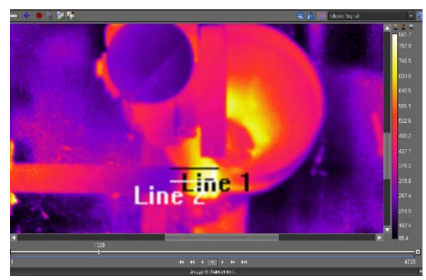
Fig. 4 illustrates the temperature distributions of a cut (Line1) and an uncut (Line2) part of the workpiece in the middle phase of the abrasive cutting process of steel 42Cr4. The surface temperature of the cut-off wheel, workpiece and the piece being cut can be read on Fig. 4a. Fig. 4b shows the distribution of the surface temperature of the uncut part.



a) temperature distribution along Line1 with a cut



b) temperature distribution along Line2 /without a cut



c) thermogram with marked lines on the workpiece cut and uncut part

Fig. 4 Temperature distributions and sample thermogram in the middle phase of the abrasive cutting process of steel 42Cr4

B. Experimental results and modelling

The designs of the experiments with the values of the studied response variables of the elastic abrasive cutting process are presented in Tables III and IV.

After statistical analysis of the experimental results by using the regression analysis method and QstatLab [27], theoretical and experimental models of the temperature of the workpiece, cut-off wheel and cut piece have been built (Table V). Tables III and IV show the values of the studied parameters which are based on the above models. The calculated $\hat{F}_g$ and tabular $F_{g(\alpha,\nu_1,\nu_2)}$ values of the Fisher criterion ($\alpha = 0.05$ is the significance level; $\nu_1 = k-1$ and $\nu_2 = N-k$ are degrees of freedom; k is the number of coefficients in the model), and the values of the determination coefficient $\hat{R}_g^2$ for each regression model are presented in Table V. The constructed models are relevant since the condition $\hat{F}_g > F_{g(\alpha,\nu_1,\nu_2)}$ has been met with a confidence level of 95%. They describe with high accuracy the dependencies between the studied response variables and the control factors. The values of the coefficient of determination are: $\hat{R}_g^2 = 0.849 - 0.965$.

To determine the impact rate of the control factors on the temperature during elastic abrasive cutting, an Analysis of Variance (ANOVA) has been conducted.

The effect of the cutting conditions on the temperature according to the created theoretical and experimental models (Table V) is presented graphically in Figs. 5, 6, and 7.

C. Analysis of the experimental results

The analysis of the theoretical and experimental models (Table V) and the graphics plotted on the basis of them (Figs. 4, 5 and 6), as well as the interpretation of the ANOVA results, makes it possible to draw the following conclusions:

1) Among all factors under study the workpiece rotational frequency has the greatest effect on temperature during elastic abrasive cutting:

Table III Design of the experiments and response variables of the elastic abrasive cutting process (in cutting of steel C45)

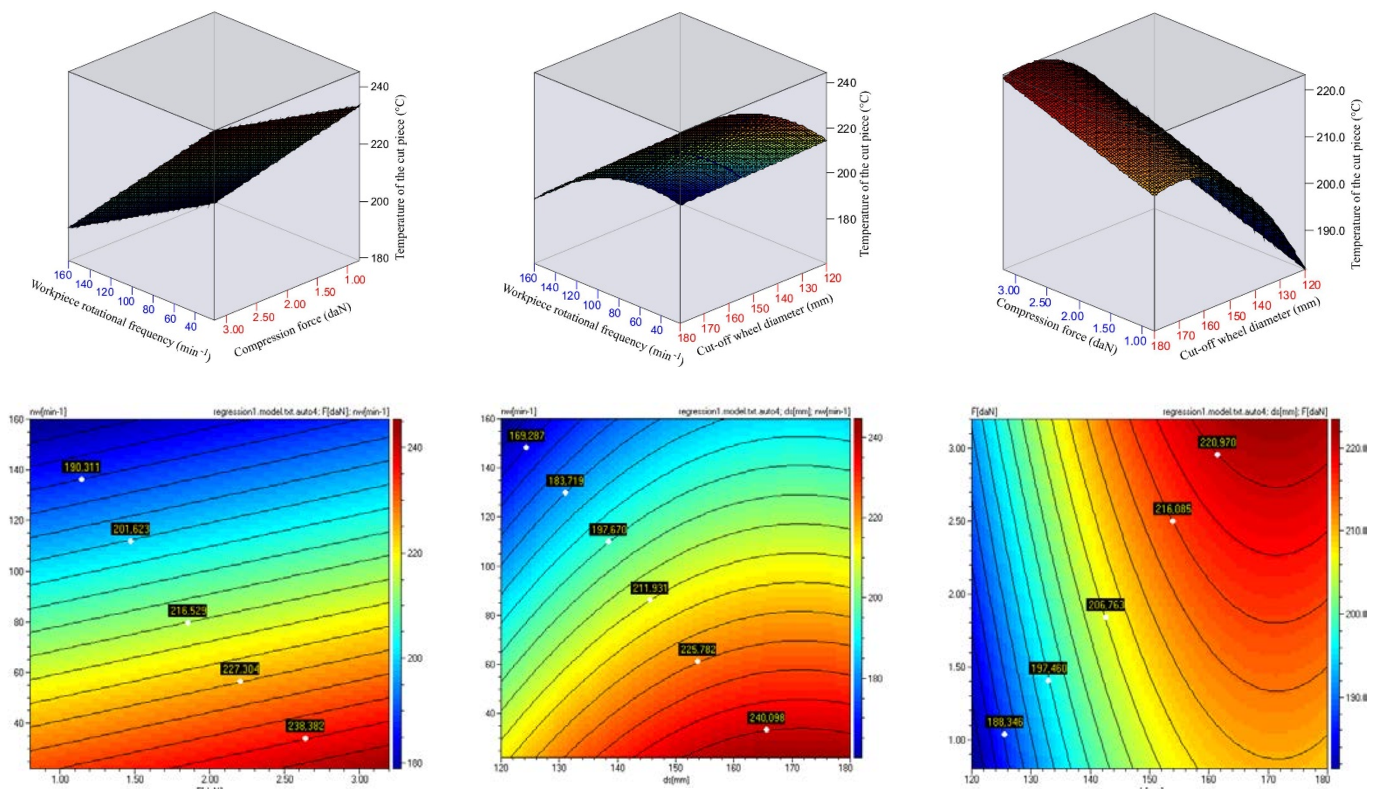
No	Control factors			Response variables					
	Cut-off wheel diameter	Compression force	Workpiece rotational frequency	Temperature of the cut piece		Maximum temperature of the cut-off wheel		Maximum temperature of the workpiece	
				Studied	Calculated	Studied	Calculated	Studied	Calculated
	d_s	F	n_w	$T_{d,C45}$	$\hat{T}_{d,C45}$	$T_{s,C45}$	$\hat{T}_{s,C45}$	$T_{w,C45}$	$\hat{T}_{w,C45}$
	(mm)	(daN)	(min^{-1})	(ºC)	(ºC)	(ºC)	(ºC)	(ºC)	(ºC)
1	120	22	1	201	195.0	160	159.4	970	946.6
2	180	22	1	220	222.4	195	186.2	830	819.0
3	120	22	3	208	206.2	175	178.6	989	969.2
4	180	22	3	235	233.6	205	205.4	863	841.6
5	120	160	1	145	145.4	135	131.6	1093	1073.9
6	180	160	1	170	172.8	150	158.4	950	946.3
7	120	160	3	152	156.6	160	150.8	1125	1096.5
8	180	160	3	184	184.0	180	177.6	965	968,9
9	120	91	2	173	175.8	149	155.1	907	927.0
10	180	91	2	207	203.2	183	181.9	838	799.4
11	150	91	0,8	193	193.6	157	158.9	865	922.3
12	150	91	3,2	206	204.8	173	178.1	879	944.9
13	150	22	2	215	224.0	185	182.4	814	823.6
14	150	160	2	180	174.4	156	154.6	933	950.9
15	150	91	2	202	199.2	165	168.5	872	863.2

Table IV Design of the experiments and response variables of the elastic abrasive cutting process (in cutting of steel 42Cr4)

No	Control factors			Response variables					
	Cut-off wheel diameter	Compression force	Workpiece rotational frequency	Temperature of the cut piece		Maximum temperature of the cut-off wheel		Maximum temperature of the workpiece	
				Studied	Calculated	Studied	Calculated	Studied	Calculated
	d_s	F	n_w	$T_{d,42Cr4}$	$\hat{T}_{d,42Cr4}$	$T_{s,42Cr4}$	$\hat{T}_{s,42Cr4}$	$T_{w,42Cr4}$	$\hat{T}_{w,42Cr4}$
	(mm)	(daN)	(min^{-1})	(ºC)	(ºC)	(ºC)	(ºC)	(ºC)	(ºC)
1	120	1	22	215	195.0	164	164.2	989	982.4
2	180	1	22	235	222.4	200	191.8	850	851.0
3	120	3	22	223	206.2	179	184.8	1008	1005,4
4	180	3	22	251	233.6	210	212.4	880	874.0
5	120	1	160	154	145.4	144	141.0	1149	1134.0
6	180	1	160	180	172.8	160	168.6	1000	1002.6
7	120	3	160	161	156.6	172	161.6	1184	1157,0
8	180	3	160	195	184.0	193	189.2	1015	1025.6
9	120	2	91	184	175.8	156	162.9	936	987.1
10	180	2	91	222	203.2	190	190.5	864	855.7
11	150	0,8	91	205	193.6	165	166.4	889	906.9
12	150	3,2	91	219	204.8	182	187.0	905	929.9
13	150	2	22	230	224.0	196	188.3	838	817.5,
14	150	2	160	192	174.4	164	165.1	956	969.1
15	150	2	91	215	199.2	175	176.7	900	864.6

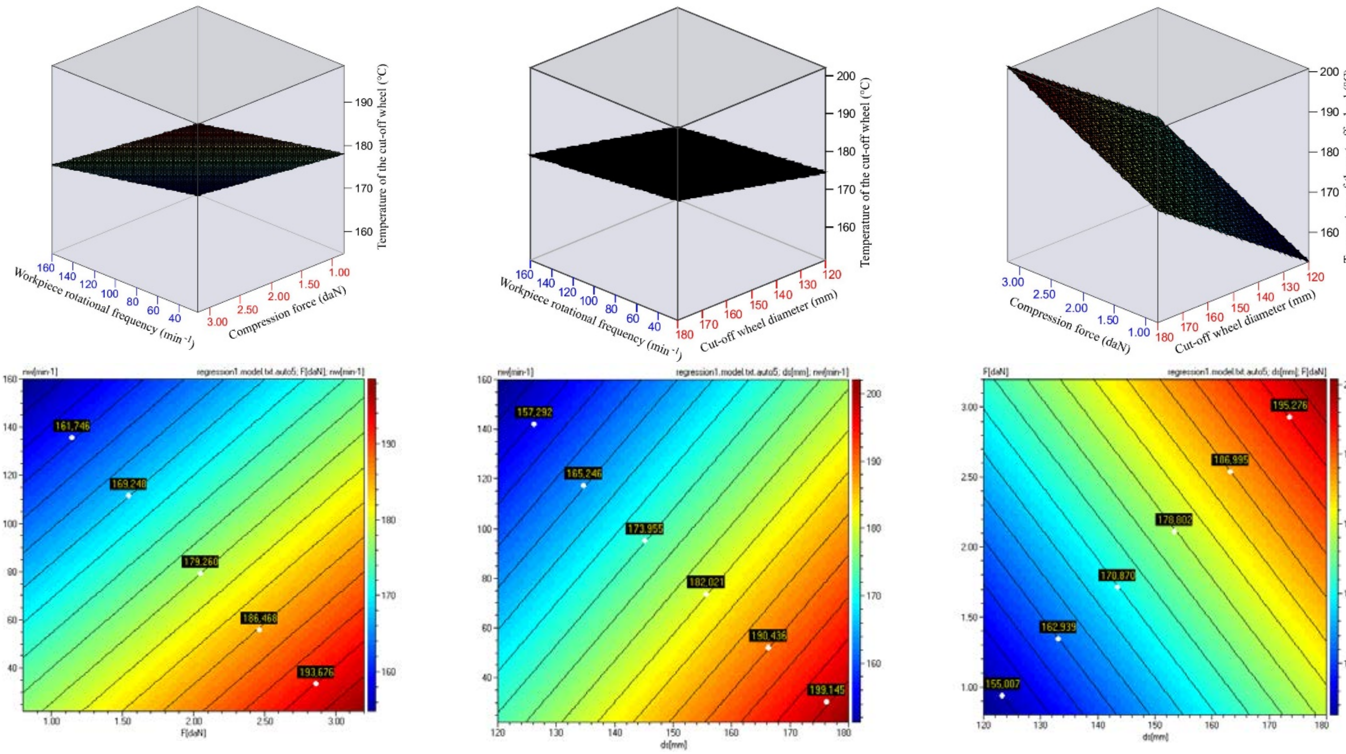
Table V Theoretical and experimental models of the temperature during elastic abrasive cutting and statistic characteristic of the models

Steel, type	Response variables	Models	Fisher criterion		Determination coefficient
			Calculated	Tabular	
			$\hat{F}_g$	$F_{g(\alpha,\nu_1,\nu_2)}$	$\hat{R}_g^2$
C45	Temperature of the cut piece	$T_{d,C45} = -88.426 + 3.69 d_s + 4.667F - 0.359 n_w - 0.011 d_s^2$	98.168	3.478	0.965
	Maximum temperature of the cut-off wheel	$T_{s,C45} = 103.865 + 0.447 d_s + 8F - 0.201 n_w$	48.371	3.587	0.910
	Maximum temperature of the workpiece	$T_{w,C45} = 1317.059 - 2.127 d_s - 186.281F + 48.924F^2 + 0.005 n_w^2$	20.699	3.478	0.849
42Cr4	Temperature of the cut piece	$T_{d,42Cr4} = -89.928 + 3.887 d_s + 5F - 0.394 n_w - 0.011 d_s^2$	90.495	3.478	0.962
	Maximum temperature of the cut-off wheel	$T_{d,42Cr4} = -89.928 + 3.887 d_s + 5F - 0.394 n_w - 0.011 d_s^2$	35.092	3.587	0.880
	Maximum temperature of the workpiece	$T_{w,42Cr4} = 2965.024 - 21.143 d_s - 140.028F + 0.063 d_s^2 + 37.403F^2 + 0.006 n_w^2$	38.494	3.482	0.931



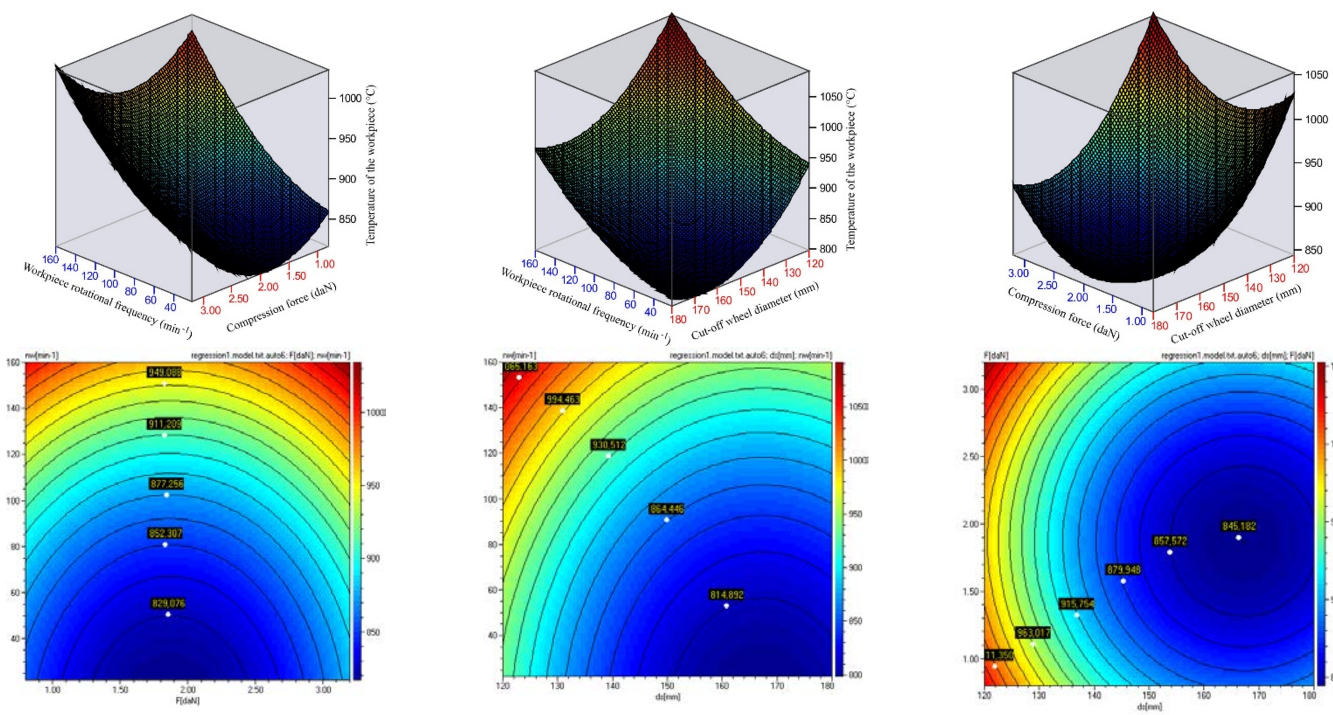
a) cut-off wheel diameter $d_s = 150$ mm b) compression force $F = 2$ daN c) workpiece rotational frequency $n_w = 91\,\text{min}^{-1}$

Fig. 5 Effect of the elastic abrasive cutting conditions (cut-off wheel diameter d_s, compression force F and workpiece rotational frequency n_w) on the temperature of the cut piece T_d (for steel 42Cr4)



a) cut-off wheel diameter $d_s = 150$ mm b) compression force $F = 2$ daN c) workpiece rotational frequency $n_w = 91\,\text{min}^{-1}$

Fig. 6 Effect of the elastic abrasive cutting conditions (cut-off wheel diameter d_s, compression force F and workpiece rotational frequency n_w) on the temperature of the cut-off wheel T_s (for steel 42Cr4)



a) cut-off wheel diameter $d_s = 150$ mm b) compression force $F = 2$ daN c) workpiece rotational frequency $n_w = 91\,\text{min}^{-1}$

Fig. 7 Effect of the elastic abrasive cutting conditions (cut-off wheel diameter d_s, compression force F and workpiece rotational frequency n_w) on the temperature of the workpiece T_w (for steel 42Cr4)

- When the workpiece rotational frequency n_w rises within the range being studied, the cut piece temperature drops by up to 29% . That change is related to the higher thickness of the layer being cut and the larger cross-section of the chip being cut by one abrasive grain, which actually enhances heat extraction, as well as to the longer cutting time [15], [16], [25].

- An increase in the workpiece rotational frequency, on the other hand, leads to an increase in the workpiece temperature (by up to 12%) and a decrease in the cut piece temperature (by up to 19%). That is linked to an increase in the contact area between the cut-off wheel and the workpiece caused by an increase in the contact arc length [15], [16], as well as to the fact that during the cutting process the workpiece appears a tool cooler absorbing part of the heat been released, which consequently is transferred to the chip

2) When the cut-off wheel diameter decreases d_s within the range being studied, the temperature of the cut piece and cut-off wheel decreases whereas the workpiece temperature rises and the variation is within the range of 11% -17%. That change is related to the higher thickness of the layer being cut and the cross-section of the chip being cut by one abrasive grain [15], [16], which actually enhances heat extraction, as well as to the longer abrasive cutting time [25] and lower cutting rate.

3) Compression force has the least effect on temperature. When it increases, the temperature of the workpiece, cut-off wheel and cut piece also increases by 5% - 11%. The minimum effect of the compression force is linked to the fact that an increase in F , on one hand, reduces the elastic abrasive cutting time, and on the other hand, increases the contact arc length and cutting depth [15], [16], [25].

4) The nature of the effect of the workpiece rotational frequency, cut-off wheel diameter and compression force on temperature during the elastic abrasive cutting is identical for both materials under study (steels C45 and 42Cr4). However, the temperature of the cut-off wheel and workpiece is higher for machining steel 42Cr4 (from 4% to 7%) since this material is harder and stronger.

III. Optimization of the Elastic Abrasive Cutting Conditions

Each temperature parameter of the elastic abrasive cutting process is of particular significance but it alone is not sufficient for the optimal process control. Therefore, the optimal values of the cut piece, cut-off wheel and workpiece could be obtained if different values of control factors (cut-off wheel diameter, compression force, workpiece rotational frequency, type of material being processed) are combined. Multi-objective optimization provides much more information so that a reasoned decision on the selection of optimal conditions of elastic abrasive cutting can be made. A variety of multi-objective optimization algorithms are known. They differ in the type and number of parameters and the method of determining the optimal solution [28]–[30].

To determine the optimal conditions of elastic abrasive cutting, multi-objective optimization has been performed. An area where the temperature parameters being studied obtain minimal values has been defined. The optimization problem is reduced to the following system of inequalities:

$$\left|\begin{array}{l} d_{s,l} \le d_s \le d_{s,u} \\ F_l \le F \le F_u \\ n_{w,l} \le n_w \le n_{w,u} \\ T_d = f(d_s, F, n_w) \to \min \\ T_s = f(d_s, F, n_w) \to \min \\ T_w = f(d_s, F, n_w) \to \min \end{array}\right. \tag{2}$$

where $d_{s,l}$, $d_{s,u}$, F_l, F_u, $n_{w,l}$, $n_{w,u}$ are respectively the lower and upper level of the control factors (cut-off wheel d_s, compression force F and workpiece rotational frequency n_w) - Table II.

Models $T_d = f(d_s, F, n_w)$, $T_s = f(d_s, F, n_w)$ and $T_w = f(d_s, F, n_w)$, reflecting the complex effect of the control factors on the temperature of the cut piece, cut-off wheel and workpiece, are presented for both materials, i.e. steels C45 and 42Cr4, in Table V.

The optimal conditions of elastic abrasive cutting that ensure the best combination of the temperature values of the cut piece, cut-off wheel and workpiece are determined by applying two methods – a genetic algorithm and a method of random search with increasing density.

The optimization problem has been solved upon cutting details from steels C45 and 42Cr4 by means of QStatLab [27]. The optimal conditions of elastic abrasive cutting are shown in Table VI.

Table VI Optimal conditions of elastic abrasive cutting

Steel, type	Optimization method	Control factors			Response variables		
		Cut-off wheel diameter d_s (mm)	Compression force F (daN)	Workpiece rotational frequency n_w (min^{-1})	Temperature of the cut piece T_d (ºC)	Maximum temperature of the cut-off wheel T_s (ºC)	Maximum temperature of the workpiece T_w (ºC)
C45	Genetic algorithm	150	2	91	199.2	168.53	863.15
	Method of random search with increasing density	120	0.96	159.48	146.35	133.02	1057.03
42Cr4	Genetic algorithm	150	2	91	212.20	176.67	864.56
	Method of random search with increasing density	120	0.8	159.99	146.35	140.97	1034.02

IV. Conclusion

As a result of the experimental study of thermal phenomena in elastic abrasive cutting, based on infrared thermography and designed experiments, the following results have been achieved:

1) According to the conditions of the elastic abrasive cutting process (cut-off wheel diameter, compression force and workpiece rotational frequency), relevant regression models for the temperature parameters (cut piece temperature, maximum cut-off wheel temperature, maximum workpiece temperature) have been built for two materials been processed – steels C45 and 42Cr4.
2) On the basis of the above regression models and ANOVA it has been established that the workpiece rotational frequency has the greatest effect on temperature. An increase in n_w within the range being studied results in a decrease in the cut piece temperature and cut-off wheel temperature (respectively by maximum 29% and 19%), and an increase in the workpiece temperature by maximum 12%. That change is related to the enhanced heat extraction caused by the higher thickness of the layer being cut and the larger cross-section of the chip being cut by one abrasive grain, the longer cutting time, the larger contact area between the cut-off wheel and the workpiece due to the increase of the contact arc length.
3) By applying multi-objective optimization, a genetic algorithm and a method of random search with increasing density, the optimal conditions of elastic abrasive cutting (cut-off wheel diameter d_s, compression force F and workpiece rotational frequency n_w) of details of steels C45 and 42Cr4, ensuring the best combination of the temperature values of the cut piece, cut-off wheel and work piece, have been determined – Table VI.

The achieved results confirm the capabilities of infrared thermography as a relevant tool for contactless and non-invasive study and for determining the process of and tools for elastic abrasive cutting of turning workpieces. Those results provide possibilities for heat flux control in elastic abrasive cutting by selecting optimal conditions for process implementation so that they can be used in all enterprises in the sector of machine building. In addition, they contribute to higher cut-off wheel durability, higher process intensity and better quality of the surface being processed.

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