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Optimization of Milling Parameters for Burr Suppression in Aluminum Alloys Using Taguchi Method

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Abstract: This study optimizes milling parameters to suppress burr formation in aluminum alloys (5A06, 6061, 6063) using Taguchi L9 orthogonal experiments and ANOVA. Cutting speed (1000-5000 r/min), feed rate (0.01-0.1 mm/r), and depth of cut (1-5 mm) were evaluated for exit-side (B1) and side-direction (B2) burr dimensions. Signal-to-noise ratio analysis identified optimal parameters: 5000 r/min speed, 0.055 mm/r feed, 1 mm depth for 5A06/6061, and 5000 r/min, 0.01 mm/r feed, 1 mm depth for 6063. Parameter influence hierarchies revealed feed rate dominant for 5A06/6061, while cutting speed most critical for 6063, with depth of cut least impactful across all alloys. ANOVA statistically validated these trends, confirming alloy-specific control mechanisms. Validation achieved up to 90% burr reduction, providing a practical framework to eliminate deburring in aluminum milling processes.

Keywords: *Burr; Milling; Signal to Noise; Analysis of Variance; Taguchi Method.*

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I. INTRODUCTION

Burr formation is a common issue in metal cutting processes. The presence of burrs not only reduces machining accuracy and surface quality but also affects product performance and can even lead to accidents. Typically, deburring processes are used to address this issue. However, deburring is a non-productive step that increases costs, prolongs production cycles, and may result in product scrapping if not performed properly, leading to economic losses [1].

This study systematically analyzes the main factors influencing burr formation during milling, optimizes cutting parameters to minimize burr size, and explores effective methods to suppress burr formation in aluminum alloy milling. The Taguchi method was employed to design orthogonal array experiments [2-3]. The Taguchi method simplifies experimental procedures without requiring complex statistical calculations. The signal-to-noise (S/N) ratio is used as a performance metric, serving as the objective function for optimization. The S/N ratio considers both the mean (signal) and variability (noise) of the output. The quality characteristics of the S/N ratio include "lower is better" (LB), "higher is better" (HB), and "nominal is best" (NB). For burr minimization, the LB characteristic was selected. ANOVA [4-6] was then conducted to evaluate the significance of process parameters. By analyzing the S/N ratios and ANOVA results, the optimal parameter combinations were identified and validated through confirmation experiments.

II. EXPERIMENTAL METHOD

The milling experiments were performed on three aluminum alloy materials: 5A06, 6061, and 6063. Slot milling was conducted on specimens measuring 50 mm in length, 50 mm in width, and 12 mm in thickness under orthogonal cutting conditions. The experiments were carried out on a CNC vertical milling machine (Hanchuan Machine Tool XK716D) using a PY-D8×20×D8×60 aluminum-specific end mill. Details of the workpiece materials and experimental conditions are listed in Table 1. The experiments involved three steps: measuring changes in burr dimensions while varying the three milling parameters (cutting speed, feed rate, and depth of cut) to explore their influence on burr formation.

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Table 1. Experimental Conditions

Experimental Material and Parameters	Content
CNC Milling Machine Model	Hanchuan Machine Tool XK716D
End Mill Model	PY-D8×20×D8×60
Workpiece Material	5A06, 6061, 6063
Cutting Speed (r/min)	1000, 3000, 5000
Feed Rate (mm/r)	0.01, 0.055, 0.1
Depth of Cut (mm)	1, 3, 5
Milling Environment	Emulsified Cutting Fluid

Figure 1 shows the aluminum alloy milling test piece, with three milled slots. This study focuses on exit-side burrs (B1) and side-direction burrs (B2). Burr height and thickness were measured using a dial indicator.

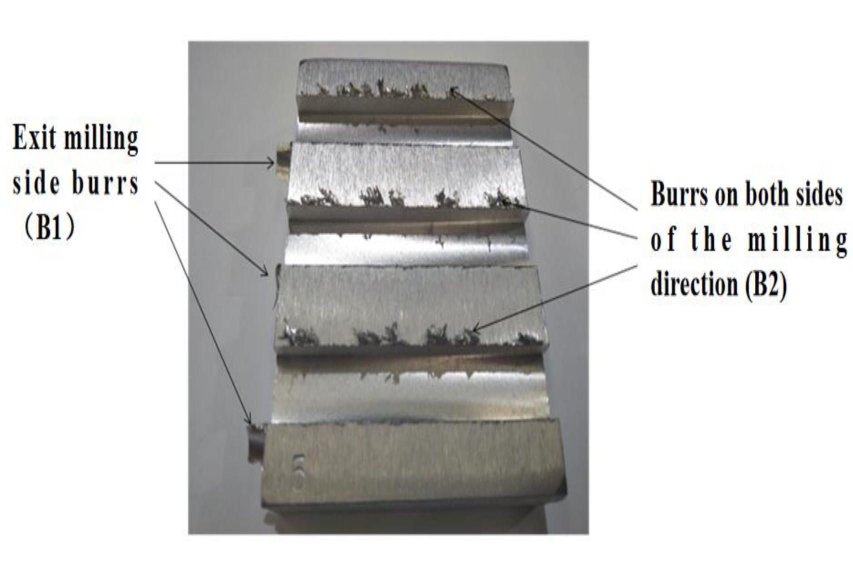

Fig 1 Milling Test Piece

The experimental data were collected using a Taguchi-based orthogonal array design. Orthogonal arrays, S/N ratios, and ANOVA were employed to study the effects of cutting speed, feed rate, and depth of cut on the milling characteristics of 5A06, 6061, and 6063 aluminum alloys. The milling parameters and their levels are listed in Table 2. The tool and workpiece materials were treated as qualitative factors, while the other factors were quantitative. The experimental plan and observed responses based on the Taguchi orthogonal array are shown in Table 3. Each material required nine experiments according to the orthogonal array design, totaling 27 experiments for the three materials.

Table 2. Milling Parameters and Their Levels

Control Factor	Unit	Level		
		1	2	3
Cutting Speed (A)	r/min	1000	3000	5000
Feed Rate (B)	mm/r	0.01	0.055	0.1
Depth of Cut (C)	mm	1	3	5

Table 3. Taguchi Orthogonal Array

Exp. No.	Cutting Speed (A)	Feed Rate (B)	Depth of Cut (C)	Measured Parameters
1	1	1	1	
2	1	2	2	
3	1	3	3	
4	2	1	2	
5	2	2	3	
6	2	3	1	
7	3	1	3	
8	3	2	2	
9	3	3	1	

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III. EXPERIMENTAL RESULTS

In the Taguchi method, "signal" represents the expected value (mean) of the output characteristic, while "noise" represents the standard deviation of the output characteristic. The S/N ratio measures the deviation from the desired quality characteristic. This study used burr height as the performance characteristic and analyzed its S/N ratio. For burr height minimization, the LB (lower is better) criterion was applied to calculate the S/N ratio, given by:

$$S/N = -10\log(\sum M.S.D) \quad (1)$$

where M.S.D is the mean squared deviation of the output characteristic. The S/N ratios for the observed responses of 5A06, 6061, and 6063 aluminum alloys are listed in Tables 4-6.

Table 4. 5A06 Aluminum Alloy – Experimental Plan and Observed Responses

No.	Cutting Speed (r/min)	Feed Rate (mm/r)	Depth of Cut (mm)	B1		B2	
				B1 Height (mm)	B1 Thickness (mm)	B2 Height (mm)	B2 Thickness (mm)
1	1000	0.01	1	5.88	0.064	0.155	0.054
2	1000	0.055	2	4.976	0.093	0.134	0.032
3	1000	0.1	3	2.64	0.117	0.201	0.056
4	3000	0.01	2	3.077	0.031	4.148	0.027
5	3000	0.055	3	0.293	0.091	0.111	0.041
6	3000	0.1	1	0.166	0.073	0.046	0.034
7	5000	0.01	3	1.543	0.022	3.14	0.02
8	5000	0.055	1	0.061	0.017	0.043	0.017
9	5000	0.1	2	0.358	0.071	0.027	0.031

Table 5 Experimental Plan and Observed Responses Based on Taguchi Method Orthogonal Array for 6061 Aluminum Alloy

No.	Milling Speed (r/min)	Feed Rate(mm/r)	Depth of Cut(mm)	B1		B2	
				Burr Height(mm)	Burr Thickness(mm)	Burr Height(mm)	Burr Thickness(mm)
1	1000	0.01	1	3.463	0.032	4.168	0.027
2	1000	0.055	2	2.873	0.093	1.481	0.042
3	1000	0.1	3	3.064	0.11	1.528	0.073
4	3000	0.01	2	3.007	0.033	4.863	0.037
5	3000	0.055	3	0.282	0.099	0.129	0.033
6	3000	0.1	1	0.143	0.061	0.113	0.034
7	5000	0.01	3	2.126	0.018	4.05	0.028
8	5000	0.055	1	0.052	0.012	0.039	0.016
9	5000	0.1	2	0.352	0.077	0.067	0.03

Table 6 Experimental Plan and Observed Responses Based on Taguchi Method Orthogonal Array for 6063 Aluminum Alloy

No.	Milling Speed(r/min)	Feed Rate(mm/r)	Depth of Cut(mm)	B1		B2	
				Burr Height(mm)	Burr Thickness(mm)	Burr Height(mm)	Burr Thickness(mm)
1	1000	0.01	1	2.976	0.035	4.602	0.031
2	1000	0.055	2	1.854	0.076	2.713	0.033
3	1000	0.1	3	1.595	0.07	3.095	0.072
4	3000	0.01	2	0.083	0.041	0.052	0.023
5	3000	0.055	3	0.37	0.07	0.083	0.033
6	3000	0.1	1	0.158	0.044	0.128	0.043
7	5000	0.01	3	0.064	0.026	0.067	0.027
8	5000	0.055	1	0.054	0.018	0.051	0.024
9	5000	0.1	2	0.49	0.071	0.075	0.041

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Table 7 Signal-to-Noise Ratio Table for 5A06 Aluminum Alloy

Level	Milling Speed(r/min)	Feed Rate (mm/r)	Depth of Cut(mm)
1	-6.5799	-7.4897	13.067
2	9.2931	11.9642	-0.4806
3	12.6654	10.9041	2.7921
Delta	19.2453	19.4538	13.5476
Rank	2	1	3

From the signal-to-noise (S/N) ratio table of the 5A06 aluminum alloy, it can be observed that the optimal parameter combination for minimizing burr height and thickness is A3B2C1, corresponding to the maximum S/N ratio across all control parameters. As shown in Table 7, the order of influence on burr height and thickness during the milling of 5A06 aluminum alloy is: feed rate, cutting speed, and depth of cut.

Table 8 Signal-to-Noise Ratio Table for 6061 Aluminum Alloy

Level	Milling Speed(r/min)	Feed Rate(mm/r)	Depth of Cut(mm)
1	-5.836	-8.3225	13.6412
2	8.9375	13.6401	0.4708
3	12.298	10.082	1.2875
Delta	18.1339	21.9626	13.1704
Rank	2	1	3

From the signal-to-noise (S/N) ratio table for 6061 aluminum alloy, it can be seen that the optimal parameter combination for minimizing burr height and thickness is A3B2C1, which corresponds to the maximum S/N ratio among all control parameters. As shown in Table 8, the order of influence factors on burr height and thickness during milling of 6061 aluminum alloy is: feed rate, cutting speed, and depth of cut.

Table 9 Signal-to-Noise Ratio Table for 6063 Aluminum Alloy

Level	Milling Speed(r/min)	Feed Rate(mm/r)	Depth of Cut(mm)
1	-5.558	14.190	12.899
2	19.681	13.038	11.400
3	21.990	8.885	11.824
Delta	27.549	5.305	1.489
Rank	1	2	3

The S/N ratio analysis of 6063 aluminum alloy reveals that the optimal parameter combination (A3B1C1) for minimizing both burr height and thickness corresponds to the maximum S/N ratio across all controlled parameters. As demonstrated in Table 9, the milling process for 6063 aluminum alloy shows the following order of parameter influence on burr dimensions: cutting speed exerts the most significant effect, followed by feed rate, with depth of cut having the least impact.

Table 10 Analysis of Variance Results for B1 Burr Height Generated During Milling of 5A06 Aluminum Alloy

No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	847.55	423.774	68.91	significant
B	Feed Rate	2	504.82	252.411	41.04	significant
C	Depth of Cut	2	266.27	133.137	21.65	significant
Error		2	12.30	6.150		
Total		8	1630.94			

DOF：degrees of freedom；SS：sequential sums of squares；MS：adjusted sums of squares；F：F-value；F_{table} at 95% confidence level is $F_{0.05,2,8}$=4.46，$F_{exp}\geq F_{table}$。

Analysis of Variance (ANOVA) aims to identify which design parameters significantly affect quality characteristics. Table 10 presents the ANOVA results for B1 burr height during milling of 5A06 aluminum alloy. The findings demonstrate that cutting speed, feed rate, and depth of cut exhibit statistically significant effects on burr height at a 95% confidence level. These three parameters are therefore confirmed as critical milling factors that substantially influence burr height formation under the specified confidence threshold.

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Table 11 Analysis of Variance Results for B1 Burr Thickness Generated During Milling of 5A06 Aluminum Alloy

No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	137.07	68.536	3.11	significant
B	Feed Rate	2	87.32	43.660	1.91	Not significant
C	Depth of Cut	2	17.47	8.735	0.38	Not significant
Error		2	45.61	22.807		
Total		8	287.48			

DOF：degrees of freedom；SS：sequential sums of squares；MS：adjusted sums of squares；F：F-value；F_{table} at 90% confidence level is $F_{0.1,2,8}$=3.11，$F_{exp} \geq F_{table}$。

Table 11 presents the ANOVA results for B1 burr thickness during milling of 5A06 aluminum alloy. The analysis reveals that cutting speed demonstrates statistically significant influence on burr thickness at a 90% confidence level, establishing it as a critical milling parameter for burr thickness control. However, other examined factors (feed rate and depth of cut) did not show statistically significant effects at this confidence level.

Table 12 Analysis of Variance Results for B2 Burr Height Generated During Milling of 5A06 Aluminum Alloy

No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	48.21	24.11	0.17	Not significant
B	Feed Rate	2	1230.32	615.16	4.42	significant
C	Depth of Cut	2	394.11	197.05	1.42	Not significant
Error		2	278.13	139.07		
Total		8	1950.77			

DOF：degrees of freedom；SS：sequential sums of squares；MS：adjusted sums of squares；F：F-value；F_{table} at 90% confidence level is $F_{0.1,2,8}$=3.11，$F_{exp} \geq F_{table}$。

Table 12 shows the ANOVA results for B2 burr height in the milling process of 5A06 aluminum alloy. The results indicate that feed rate has a statistically significant impact on burr height at the 90% confidence level, confirming it as a key milling parameter affecting burr height formation. No other factors (cutting speed and depth of cut) showed significant effects at this confidence level.

Table 13 Analysis of Variance Results for B2 Burr Thickness Generated During Milling of 5A06 Aluminum Alloy

No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	62.263	31.132	3.21	significant
B	Feed Rate	2	12.709	6.355	0.66	Not significant
C	Depth of Cut	2	3.882	1.941	0.20	Not significant
Error		2	19.380	9.690		
Total		8	98.235			

DOF：degrees of freedom；SS：sequential sums of squares；MS：adjusted sums of square；F：F-value；F_{table} at 90% confidence level is $F_{0.1,2,8}$=3.11，$F_{exp} \geq F_{table}$。

Table 13 presents the ANOVA results for B2 burr thickness during 5A06 aluminum alloy milling. The analysis demonstrates that cutting speed shows statistically significant effects on burr thickness at the 90% confidence level, confirming its status as a dominant milling parameter for burr thickness control. Other process parameters (feed rate and depth of cut) were found to be statistically insignificant at this confidence threshold.

Table 14 Analysis of Variance Results for B1 Burr Height Generated During Milling of 6061 Aluminum Alloy

No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	639.13	319.565	56.88	significant
B	Feed Rate	2	549.85	274.925	48.93	significant
C	Depth of Cut	2	345.63	172.817	30.76	significant
Error		2	11.24	5.618		
Total		8	1545.85			

DOF：degrees of freedom；SS：sequential sums of squares；MS：adjusted sums of squares；F：F-value；F_{table} at 95% confidence level is $F_{0.05,2,8}$=4.46，$F_{exp} \geq F_{table}$。

Table 14 displays the ANOVA results for B1 burr height during the milling of 6061 aluminum alloy. The results demonstrate that cutting speed, feed rate, and depth of cut all exhibit statistically significant effects on burr height at the 95% confidence level. These three parameters are therefore identified as critical milling factors that substantially influence burr height formation under this confidence threshold.

Table 15 Analysis of Variance Results for B1 Burr Thickness Generated During Milling of 6061 Aluminum Alloy

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No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	128.19	64.10	3.43	significant
B	Feed Rate	2	137.34	68.67	3.68	significant
C	Depth of Cut	2	82.91	41.46	2.22	Not significant
Error		2	37.32	18.66		
Total		8	385.77			

DOF：degrees of freedom；SS：sequential sums of squares；MS：adjusted sums of squares；F：F-value；F_{table} at 90% confidence level is $F_{0.1,2,8}$=3.11，$F_{exp} \geq F_{table}$。

Table 15 presents the ANOVA results for B1 burr thickness during 6061 aluminum alloy milling operations. The analysis reveals that both cutting speed and feed rate demonstrate statistically significant effects on burr thickness at the 90% confidence level, establishing them as key controlling parameters for burr thickness. The depth of cut parameter showed no statistically significant influence at this confidence level.

Table 16 Analysis of Variance Results for B2 Burr Height Generated During Milling of 6061 Aluminum Alloy

No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	617.6	308.81	5.39	significant
B	Feed Rate	2	1386.9	693.45	12.09	significant
C	Depth of Cut	2	210.9	105.47	1.84	Not significant
Error		2	114.7	57.34		
Total		8	2330.1			

DOF：degrees of freedom；SS：sequential sums of squares；MS：adjusted sums of squares；F：F-value；F_{table} at 95% confidence level is $F_{0.05,2,8}$=4.46，$F_{exp} \geq F_{table}$。

Table 16 presents the ANOVA results for B2 burr height in the milling process of 6061 aluminum alloy. The results indicate that both cutting speed and feed rate exhibit statistically significant effects on burr height at the 95% confidence level, confirming their status as dominant milling parameters for burr height control. No other process variables (including depth of cut) demonstrated statistically significant influence at this confidence threshold.

Table 17 Analysis of Variance Variance Variance Results for B2 Burr Thickness Generated During Milling of 6061 Aluminum Alloy

No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	42.361	21.180	12.66	significant
B	Feed Rate	2	20.786	10.393	6.21	significant
C	Depth of Cut	2	31.806	15.903	9.51	significant
Error		2	3.345	1.672		
Total		8	98.297			

DOF：degrees of freedom；SS：sequential sums of squares；MS：adjusted sums of squares；F：F-value；F_{table} at 90% confidence level is $F_{0.1,2,8}$=3.11，$F_{exp} \geq F_{table}$。

Table 17 presents the ANOVA results for B2 burr thickness during the milling of 6061 aluminum alloy. The analysis demonstrates that cutting speed, feed rate, and depth of cut all show statistically significant effects on burr thickness at the 95% confidence level. These three machining parameters are therefore confirmed as critical factors that substantially influence burr thickness formation under this statistical confidence threshold.

Table 18 Analysis of Variance Results for B1 Burr Height Generated During Milling of 6063 Aluminum Alloy

No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	1094.84	547.421	4.23	significant
B	Feed Rate	2	53.65	26.826	0.21	Not significant
C	Depth of Cut	2	15.26	7.630	0.06	Not significant
Error		2	259.13	129.564		
Total		8	1422.88			

DOF：degrees of freedom；SS：sequential sums of squares；MS：adjusted sums of squares；F：F-value；F_{table} at 90% confidence level is $F_{0.1,2,8}$=3.11，$F_{exp} \geq F_{table}$。

Table 18 presents the ANOVA results for B1 burr height during 6063 aluminum alloy milling. The analysis reveals that cutting speed demonstrates statistically significant influence on burr height at the 90% confidence level, establishing it as a pivotal milling parameter for burr height control. Other examined factors (feed rate and depth of cut) did not exhibit statistically significant effects at this confidence threshold.

Table 19 Analysis of Variance Results for B1 Burr Thickness Generated During Milling of 6063 Aluminum Alloy

No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	41.10	20.552	2.20	Not significant
B	Feed Rate	2	39.38	19.689	2.11	Not significant
C	Depth of Cut	2	58.22	29.109	3.12	significant
Error		2	18.66	9.330		
Total		8	157.36			

DOF : degrees of freedom ; SS : sequential sums of squares ; MS : adjusted sums of squares ; F : F-value ; F_{table} at 90% confidence level is $F_{0.1,2,8}=3.11$, $F_{exp} \geq F_{table}$。

Table 19 shows the ANOVA results for B1 burr thickness in the milling of 6063 aluminum alloy. The results indicate that depth of cut exhibits statistically significant effects on burr thickness at the 90% confidence level, confirming its status as a key milling parameter for burr thickness control. Neither cutting speed nor feed rate showed statistically significant influence at this confidence level.

Table 20 Analysis of Variance Results for B2 Burr Height Generated During Milling of 6063 Aluminum Alloy

No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	2154.87	1077.44	106.24	significant
B	Feed Rate	2	17.30	8.65	0.85	Not significant
C	Depth of Cut	2	20.23	10.12	1.00	Not significant
Error		2	20.28	10.14		
Total		8	2212.69			

DOF : degrees of freedom ; SS : sequential sums of squares ; MS : adjusted sums of squares ; F : F-value ; F_{table} at 90% confidence level is $F_{0.1,2,8}=3.11$, $F_{exp} \geq F_{table}$。

Table 20 presents the ANOVA results for B2 burr height during the milling of 6063 aluminum alloy. The analysis demonstrates that cutting speed shows statistically significant effects on burr height at the 90% confidence level, establishing it as a dominant controlling parameter for burr height formation. Other process variables (including feed rate and depth of cut) were found to be statistically insignificant at this confidence threshold.

Table 21 Analysis of Variance Results for B2 Burr Thickness Generated During Milling of 6063 Aluminum Alloy

No.	Milling Parameters	DOF	SS	MS	F	
A	Milling Speed	2	14.6249	7.3124	140.26	significant
B	Feed Rate	2	51.5413	25.7706	494.29	significant
C	Depth of Cut	2	8.4517	4.2258	81.05	significant
Error		2	0.1043	0.0521		
Total		8	74.7221			

DOF : degrees of freedom ; SS : sequential sums of squares ; MS : adjusted sums of squares ; F : F-value ; F_{table} at 95% confidence level is $F_{0.05,2,8}=4.46$, $F_{exp} \geq F_{table}$。

Table 21 presents the ANOVA results for B2 burr thickness during 6063 aluminum alloy milling operations. The results conclusively demonstrate that cutting speed, feed rate, and depth of cut all exhibit statistically significant effects on burr thickness at the 95% confidence level. These three machining parameters are therefore classified as critical control factors that substantially determine burr thickness characteristics within the specified confidence interval.

IV. CONCLUSIONS

The machining characteristics of burr height and thickness generated during milling of three aluminum alloy materials, namely 5A06, 6061, and 6063, were studied. The experimental results are as follows:

➢ *From the S/N Ratio Response, it can be Seen that:*

- In the milling process of 5A06 aluminum alloy, the order of influence on burr height and burr thickness is: feed rate, milling speed, depth of cut. The optimal parameter combination for burr height and burr thickness is a milling speed of 5000 r/min, a feed rate of 0.055 mm/r, and a depth of cut of 1 mm.
- In the milling process of 6061 aluminum alloy, the order of influence on burr height and burr thickness is: feed rate, milling speed, depth of cut. The optimal parameter combination for burr height and burr thickness is a milling speed of 5000 r/min, a feed rate of 0.055 mm/r, and a depth of cut of 1 mm.
- In the milling process of 6063 aluminum alloy, the order of influence on burr height and burr thickness is: milling speed, feed rate, depth of cut. The optimal parameter combination for burr height and burr thickness is a milling speed of 5000 r/min, a feed rate of 0.01 mm/r, and a depth of cut of 1 mm.

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- *For the Three Aluminum Alloy Materials 5A06, 6061, and 6063, from the Results of Variance Analysis on the Burr Height and Thickness Generated During the Milling Process, it can be Seen that:*

- The variance analysis results of the B1 burr height generated during the milling of 5A06 aluminum alloy show that milling speed, feed rate, and depth of cut have a relatively significant impact on the B1 burr height, meaning that milling speed, feed rate, and depth of cut are important milling parameters affecting the B1 burr height; The variance analysis results of the B1 burr thickness generated during the milling of 5A06 aluminum alloy indicate that milling speed has a relatively significant impact on the B1 burr thickness, that is, milling speed is an important milling parameter affecting the B1 burr thickness, while the effects of other factors are not significant.
- The variance analysis results of the B2 burr height generated during the milling of 5A06 aluminum alloy show that the feed rate has a relatively significant impact on the burr height, i.e., the feed rate is an important milling parameter affecting the B2 burr height, and the effects of other factors are not significant; The variance analysis results of the B2 burr thickness generated during the milling of 5A06 aluminum alloy indicate that milling speed has a relatively significant impact on the B2 burr thickness, that is, milling speed is an important milling parameter affecting the B2 burr thickness, while the effects of other factors are not significant.
- The variance analysis results of the B1 burr height generated during the milling of 6061 aluminum alloy show that milling speed, feed rate, and depth of cut have a relatively significant impact on the B1 burr height, meaning that milling speed, feed rate, and depth of cut are important milling parameters affecting the B1 burr height; The variance analysis results of the B1 burr thickness generated during the milling of 6061 aluminum alloy indicate that milling speed and feed rate have a relatively significant impact on the B1 burr thickness, i.e., milling speed and feed rate are important milling parameters affecting the B1 burr thickness, while the effects of other factors are not significant.
- The variance analysis results of the B2 burr height generated during the milling of 6061 aluminum alloy show that milling speed and feed rate have a relatively significant impact on the B2 burr height, i.e., milling speed and feed rate are important milling parameters affecting the B2 burr height, and the effects of other factors are not significant; The variance analysis results of the B2 burr thickness generated during the milling of 6061 aluminum alloy indicate that milling speed, feed rate, and depth of cut have a relatively significant impact on the B2 burr thickness, meaning that milling speed, feed rate, and depth of cut are important milling parameters affecting the B2 burr thickness.
- The variance analysis results of the B1 burr height generated during the milling of 6063 aluminum alloy show that milling speed has a relatively significant impact on the B1 burr height, i.e., milling speed is an important milling parameter affecting the B1 burr height, and the effects of other factors are not significant; The variance analysis results of the B1 burr thickness generated during the milling of 6063 aluminum alloy indicate that the depth of cut has a relatively significant impact on the B1 burr thickness, that is, the depth of cut is an important milling parameter affecting the B1 burr thickness, while the effects of other factors are not significant.
- The variance analysis results of the B2 burr height generated during the milling of 6063 aluminum alloy show that milling speed has a relatively significant impact on the B2 burr height, i.e., milling speed is an important milling parameter affecting the B2 burr height, and the effects of other factors are not significant; The variance analysis results of the B2 burr thickness generated during the milling of 6063 aluminum alloy indicate that milling speed, feed rate, and depth of cut have a relatively significant impact on the B2 burr thickness, meaning that milling speed, feed rate, and depth of cut are important milling parameters affecting the B1 burr thickness.

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