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PARAMETERS OPTIMIZATION TO MINIMIZE THE VIBRATIONS EFFECTS DURING THE MILLING PROCESS

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ABSTRACT

In nowadays the increasing productivity in the shortest possible time and with high quality is undoubtedly one of the biggest challenges for the industry. Recently, the industry has turned to CNC machines very often, since they work automatically and are able to achieve high precision with a high performance. In this sense, the vibration has been presented during the last decades as one of the main limiting factors for the improvement of productivity specially in machining operations. This work contributes to the reduction of vibrations, proposing the use of optimization methods to minimize vibrations using milling parameters (cutting speed, feed speed, axial penetration and radial penetration) related to the section area. This study presents a theoretical analysis on the materials and tools used throughout the experimental trials, as well as the methods and programs used. During this study, two optimization methods were used: the Taguchi method and the Response Surfaces method.

Keywords: milling, milling parameters, vibrations, resonance frequency, Taguchi method, response Surfaces method.

INTRODUCTION

Technologies involving chip removal operations, also known as machining processes, have suffered tremendous advances in the last decades. The machining of new materials has demanding the development of new tools and machines as well as the optimization of the machining parameters (Grzesik, 2008). To obtain good results in machining processes it must be guarantee a low surface roughness, high removal rate and long tool life (Ribeiro, 2017). These goals are reached choosing the optimal machining parameters and minimizing the vibrations effects.

The aim of this work is development of a method that is able to optimize the machining parameters to improve the surface quality and minimize the vibrations effects. For that, the was used two different optimization methods, the Taguchi and Response Surface methods to minimize the vibrations during the machining process. The level of vibrations has a direct relation in the surface quality and the tool life.

RESULTS AND CONCLUSIONS

The vibration measurement obtained using the Taguchi and Response Surface (RSM) methods are represented in Figure 1. In Table 1 is presented the ANOVA of RMS for Y direction.



Fig. 1 - Comparison among the Taguchi and the Response Surface methods.

Table 1 - ANOVA for Y direction.

Grupo	Df	Sq	Md	F value	Contribution (%)
A	1	67.560	67.560	10.330	25.9
B	1	1.292	1.292	0.200	0.5
C	1	6.355	6.355	0.970	2.4
D	1	0.116	0.116	0.020	0.0
AxB	1	19.156	19.156	2.930	7.4
AxC	1	28.406	28.406	4.340	10.9
AxD	1	42.999	42.999	6.570	16.5
BxC	1	36.723	36.723	5.620	14.1
BxD	1	18.397	18.397	2.810	7.1
CxD	1	6.670	6.670	1.020	2.6
Residual	5	32.699	6.540		12.6
Total	15	260.372			100.0

It is possible to optimize the milling parameters to minimize the level of vibration using both optimization methods. The convergence is faster using the RSM method than the Taguchi.

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