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Title: Application of signal to noise ratio and grey relational analysis to minimize forces and vibrations during precise ball end milling

Authors: Szymon Wojciechowski, Radosław W. Maruda, Grzegorz M. Królczyk, Piotr Niesłony



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Application of signal to noise ratio and grey relational analysis to minimize forces and vibrations during precise ball end milling

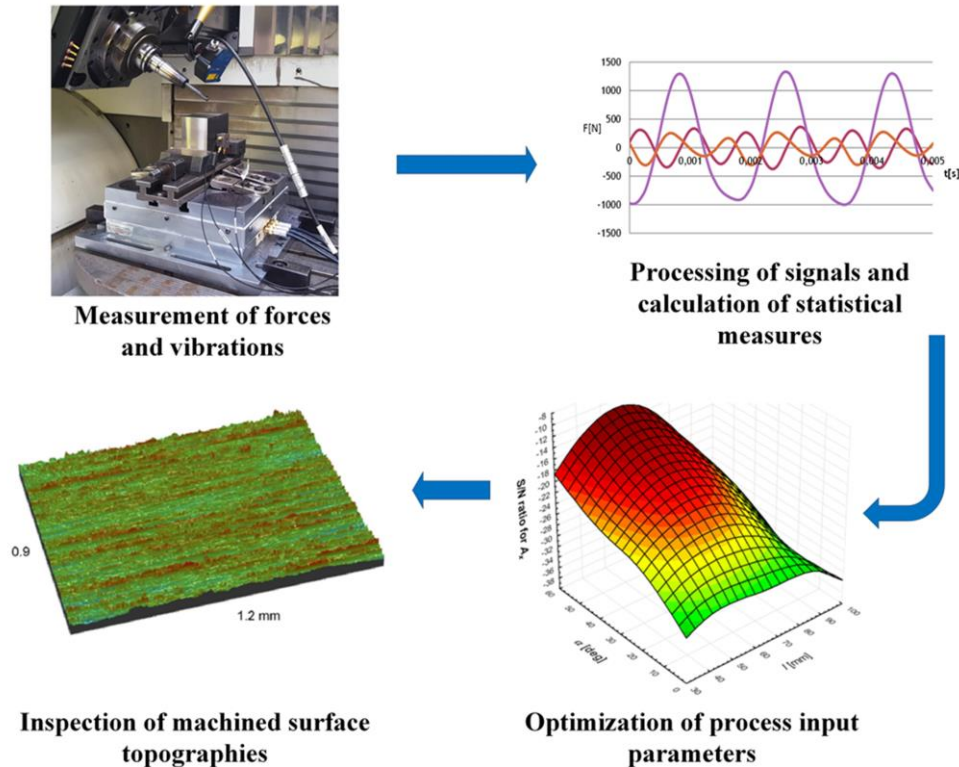
Szymon Wojciechowski^{1*}, Radosław W. Maruda², Grzegorz M. Królczyk³, Piotr Niesłony³

¹Poznan University of Technology, Piotrowo 3, Poznan 60-965, Poland, E-mail address: sjwojciechowski@o2.pl, ¹

²University of Zielona Gora, 4 Prof. Z. Szafrana street, 65-516 Zielona Gora, Poland

³Opole University of Technology, 76 Proszkowska St., Opole 45-758, Poland

Graphical Abstract



Highlights

- minimization method of forces and vibrations during precise ball end milling
- application of Taguchi method and Grey Relational Analysis
- optimal milling parameters are: inclination angle $\alpha=60^\circ$ and tool overhang $l=63$ mm
- ball end milled surface topography affected by inclination angle and overhang

Abstract. In this paper, a method for the minimization of cutting forces and vibrations during precise ball end milling of hardened 55NiCrMoV6 steel is developed. The aim of this work concentrates on the optimal selection of surface inclination angle α and tool's overhang l , which enables the minimization of cutting forces and vibrations in order to improve the machined surface quality. The experiment includes the measurement of cutting forces and acceleration of vibrations during the milling tests with variable input parameters. The next step focuses on the optimization of the ball end milling process with the consideration of the acquired signals. This procedure is carried out by the minimization of process responses with the application of signal to noise S/N ratio and grey relational analysis (GRA). Subsequently, the obtained optimal values of process input parameters are validated during the ball end milling tests involving the measurements of machined surface topographies. Research reveals that surface inclination angle and tool's overhang have significant influence on generated forces and vibration values. Moreover, the selection of the optimal values of α and l enables significant improvement of machined surface quality.

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