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Taguchi-Based Six Sigma Approach to Optimize Surface Roughness for Milling Processes

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Abstract : This paper focuses on using Six Sigma methodologies to improve the surface roughness of a manufactured part produced by the CNC milling machine. It presents a case study where the surface roughness of milled aluminum is required to reduce or eliminate defects and to improve the process capability index C_p and C_{pk} for a CNC milling process. The six sigma methodology, DMAIC (design, measure, analyze, improve, and control) approach, was applied in this study to improve the process, reduce defects, and ultimately reduce costs. The Taguchi-based six sigma approach was applied to identify the optimized processing parameters that led to the targeted surface roughness specified by our customer. A L₉ orthogonal array was applied in the Taguchi experimental design, with four controllable factors and one non-controllable/noise factor. The four controllable factors identified consist of feed rate, depth of cut, spindle speed, and surface roughness. The noise factor is the difference between the old cutting tool and the new cutting tool. The confirmation run with the optimal parameters confirmed that the new parameter settings are correct. The new settings also improved the process capability index. The purpose of this study is that the Taguchi–based six sigma approach can be efficiently used to phase out defects and improve the process capability index of the CNC milling process.

Keywords : CNC machining, six sigma, surface roughness, Taguchi methodology
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