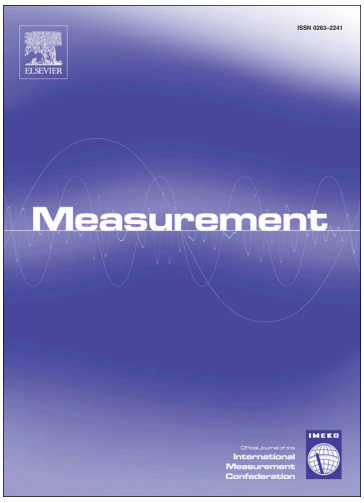

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Optimization of Two-point incremental forming process of AA1050 through response surface methodology

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Abstract

Two point incremental forming (TPIF) process is used in the industry to enhance the dimensional accuracy of formed parts. However, the process limits the formability of metal sheets due to tension between two points i.e. tool and mandrel. Hence, selection of optimum TPIF process to enhance formability is a key issue in manufacturing of complex parts. In the present work, an experimental study based on response surface methodology was made to analyze formability of aluminum 1050 in two-point incremental forming process. Here, Box-Bhenken experimental design was utilized taking into account mandrel angle, tool nose diameter, sheet initial thickness and step down as input parameters as well as thinning ratio and maximum resultant force as output responses. Analysis of variances was also performed to find contribution of factors on the responses. From the results, it was found that the wall angle is the most influential factor for thinning ratio; while, initial thickness followed by step down have great impact on forming force. By performing multi-objective optimization, it is found that for simultaneous minimization of thinning ratio and forming force, setting of 45º wall angle, 15mm tool nose diameter, 1mm initial thickness and 0.5mm step down should be selected. The obtained optimal solution was further verified by confirmatory experiment and results showed accuracy and predictability of proposed approach.

Keywords: Incremental forming; Two-point; Thinning ratio; Forming force; Optimization

1. Introduction

The incremental forming (IF) is relatively new manufacturing process that is suitable for forming of sheet material when the industry deals with batch production [1]. Deformation of sheet material in this process occurs through localized strain by movement of the tool in a programmed path computer numerical controlled machine [2]. During recent past, researchers are inspired to work on sheet metal formability and performance measures of incremental

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