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A Predictive Model of Flexibly-reconfigurable Roll Forming Process using Regression Analysis

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Abstract

Flexibly reconfigurable roll forming (FRRF) is a new and flexible forming process that can be used to produce a multi-curvature surface. The basic concept of FRRF is the formation of a curvature in the longitudinal direction by controlling the strain distribution. By the arrangement of curvature adjustment rods, various curvatures can be produced by means of rollers. The shape of the formed surface is determined by the curvature of the reconfigurable rollers and the gaps between the rollers. However, it is difficult to intuitively predict the longitudinal curvature of the formed sheet because the FRRF process produces a three-dimensional curved surface from a two-dimensional curve. To fabricate the objective surface, it is necessary to determine the appropriate input parameters. This can be rapidly done by developing a predictive model using regression analysis. The input parameters selected for the regression analysis in this study are the compression ratio of the formed sheet and curvature radius in the transverse direction. The dependent variable is the longitudinal curvature of the formed sheet. The curvatures are obtained by experiments using FRRF apparatus, and the predictions are used for the regression analysis. To verify the predictive regression model, r-squared values and root mean square errors are calculated. Through the employed procedure, it is confirmed that a statistical formula for predictive model is reasonable.

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Keywords: Flexibly-reconfigurable Roll Forming Process ; Regression Analysis ;

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1. Introduction

Multi-point dieless forming, one of the flexible forming processes, is useful to form the various curved sheet[1], but it has a disadvantage about forming size. Flexibly-reconfigurable roll forming (FRRF) process is new sheet metal forming process to improve weakness of multi-point dieless forming technology[2]. This FRRF process has no limit in rolling direction. The basic concept of FRRF is the formation of a curvature in the longitudinal direction by controlling the strain distribution. By the arrangement of curvature adjustment rods, various curvatures can be produced by means of rollers. Son et al.[3] analyzed the shape design parameters in FRRF process. Also, Yoon et al.[4] analyzed deformation of FRRF process, and suggested theoretical predictive model. However, to apply the practical case, the predictive model which apply experimental results is needed. In order to predict the practical shape result of FRRF, statistical model could be used. In this research, regression analysis is performed to make the predictive model of FRRF results. The sample data of regression analysis is obtained by FRRF experiments. To confirm the validity of the predictive model, R-squared value and root mean squared error (RMSE) value are calculated.

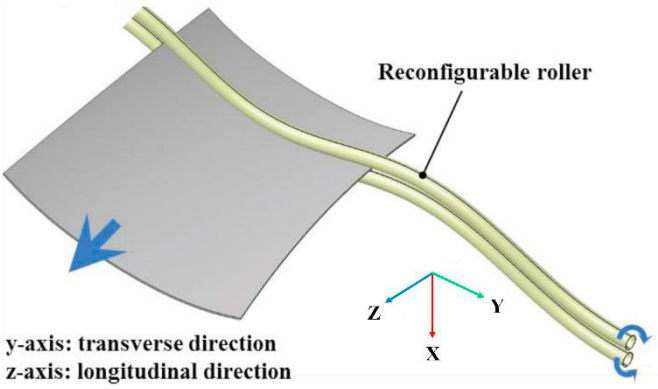

Fig. 1. Concept of FRRF.

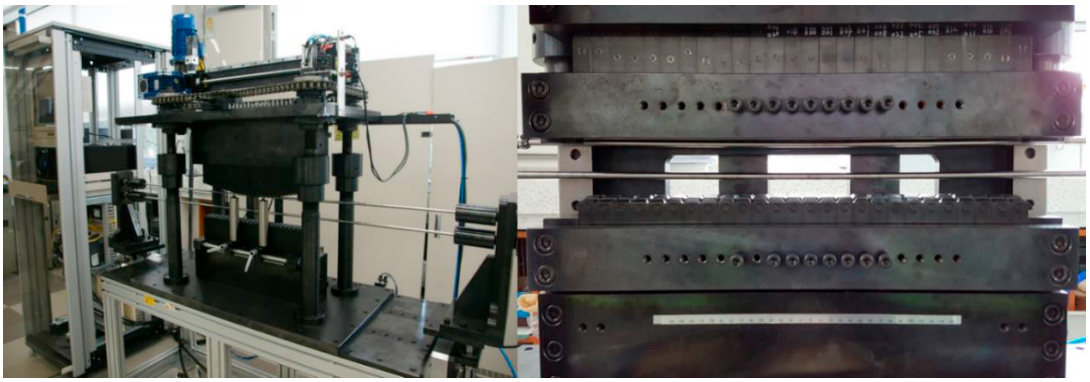

Fig. 2. FRRF apparatus

Nomenclature

β	Regression coefficient
X	Input parameter
y	Output parameter
E	Error

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