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Evaluation of Bending Strength of the Vibratory Welded Joint Using Regression Technique

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Previous researchers developed the vibrating table for producing mechanical vibrations into the weld pool during the welding process. The designed vibrating table produces the required frequency with suitable amplitude and acceleration in terms of voltages. This helps in producing a uniform and fine grain structure in the welded joints, which results in an improvement of the bending strength of the welded joints. This paper presents the implementation of the Generalized Regression Neural Network (GRNN) to establish a relation between vibration parameters such as the input voltage to the vibromotor, the time of vibration, and the bending strength of the vibratory welded joints. In order to validate the feasibility of the developed prediction tool, a comparison is made with the experimental results.

INTRODUCTION

In manufacturing industries, welding is widely used for joining metals. The welding joints prepared by the arc welding process generally offer good strength and hardness properties. Metal arc welding is the most flexible fusion welding and one of the most widely used welding processes. Mechanical vibrations into the weld specimen during the welding process improve the welded joint properties significantly. The enhancement of the welded joint properties can be altered by the variation of the vibration parameters.

Vibrations applied during welding generally reduce the residual deformation and stress and improve the mechanical properties of the weldments (Lu et al., 2006; Xu et al., 2006; Lakshminarayanan and Balasubramanian, 2010). An enhancement of the mechanical properties and the quality of the fusion metal through the use of vibration during welding was considered recently and was found to improve the bending property of the welding line, tensile strength, and morphology (Hussein et al., 2011; Munsi et al., 2001; Tewari and Shanker, 1993; Weglowska and Pietras, 2012).

The Generalized Regression Neural Network (GRNN) is a type of supervised network and has been widely accepted for its excellent ability to train rapidly on sparse data sets. The GRNN usually performs better and faster in the approximation of continuous functions. Tseng (2006) implemented the GRNN to create approximate models to establish a relation between the spot welding parameters, welded joint strength, and power required to prepare the welded joint. Kathersan et al. (2012) addressed the modelling of the welding parameters in the arc welding process by using a set of experimental data, utilizing regression analysis, and employing optimization via the particle swarm optimization algorithm.

Though there is literature that describes the phenomenon of improving the welded joint strength properties, the relation between the vibration parameters and welded joint properties has not been established. Hence, the present work is aimed at building a relation between the vibration parameters and welded joint properties from the experimental data through the use of the Generalized Regression Neural Network.

EXPERIMENTAL SETUP

Figure 1 shows the experimental setup with the vibration platform surface plate to induce vibrations during the welding process. A platform on which the specimen is placed is equipped with four springs, one at each corner. Different frequencies and amplitudes in terms of voltages input to the vibromotor are given to the specimens during welding so that the weld pool can be mechanically stirred to induce favourable microstructural effects. Since much research has been devoted to the optimization of the welding process parameters, we have considered the optimized values from previous works and have kept the welding current constant at 100A (AC current), the welding voltage constant at 23 volts, the weld specimen size at 300 mm × 100 mm × 5 mm, and the flexural test specimen size at 500 mm × 20 mm × 5 mm according to ASTM E290. The effect of vibration on the welding joint is decided by not only the vibration time but also the welding speed. However, in the present investigation, the welding speed is kept constant. The base metal is mild steel, and the welding process is arc welding. The complete experimental details are discussed in Rao et al. (2015).

EXPERIMENTAL ANALYSIS

For different combinations of voltage and time of vibration values, weld specimens are prepared and tested for the bending strength.

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