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Abstract

The aim of the present research work is two folded. First, it is intended to describe the development of a low cost force measurement setup for friction stir welding (FSW) process and second, is to demonstrate the potential of force signals combined with artificial intelligence to accurately predict ultimate tensile strength (UTS) and yield strength of the joints. In FSW process, simultaneous rotation, and translation of the tool associated with severe plastic deformation of material around the tool pin brings challenges in measurement of torque and forces experienced during welding. An attempt has been made to design and develop a strain gauge based setup for the measurement of two dimensional forces and torque during FSW process. The force signals acquired using the developed setup is then utilized to develop support vector regression based data driven models for prediction of UTS and yield strength of the welded samples. For monitoring the FSW process a new statistical indicator derived from force signals is presented. The proposed indicator brings appreciable correlation with the UTS of the joints. The prediction performances of the developed models imply that the presented approach can be effectively put forward for real time monitoring of the process.

Keywords: force measurement; torque; strain gauge; support vector regression; monitoring

Introduction

Appropriate design of friction stir welding (FSW) process demands real time measurement of process forces and torque experienced by the welding tool. By virtue of the simultaneous linear and rotary motion of the tool in the continuously deforming material imposes forces and torque on the welding tool [1,2]; measurement and control of which can be of great importance for controlling the outcome of the process. Force system as experienced during FSW

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