UNIVERSITI TEKNOLOGI MARA

INTEGRATION OF TRAVEL CONTROL SYSTEM WITH TRAVERSE TEST RIG FOR FRICTION STIR WELDING PROCESS

NUR'AMIRAH BINTI BUSU

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ABSTRACT

The Friction Stir Welding (FSW) process has been under constant development since its invention to cope with the growing markets demands worldwide. Since 2014, the research in FSW field has been conducted to address the problem mostly related to improper selection of process parameters, temperature fluctuation and machine geometric error. Improper selection of process parameters can lead to defect on the microstructure of the welded workpiece. In order to overcome the highlighted problems, optimized process parameters are essential to produce a good quality of weld formation. In this research, an integration of travel control system with traverse test rig has been developed as a platform to determine the parameters. The travel control system implemented the open-loop and closed loop control system. The open-loop control system platform enabled the observation of the temperature fluctuation at a constant travel speed. For the closed loop control system, two types of scheme has been implemented which were proportional-integral-derivative (PID) scheme and linear speed-temperature relationship scheme. To analyse the performance of the integrated system, a functionality verification process was conducted. For open-loop control system platform, the actual FSW had been carried out. From the results obtained, it shows that, with the increasing travel speed and decreasing of the tool rotational speed, the temperature of the workpiece was decreased. Meanwhile, the functionality verification of the closed loop control system shows a good agreement with the theory used for both schemes. The best controller with the lowest percentage error of 14.3% was using PID controller. PID controller shows an improvement in the travel speed stability as well as an increment in the speed of response and accuracy between the temperature fluctuation and the travel speed. Then, for the linear speed-temperature relationship scheme, a good system performance had been increased by 17.5% with increasing of travel speed. As a conclusion, the functionality of the integrated system was successfully approved. With the development of this integrated system, wide range of research in FSW can be conducted such as to study the microstructure and the quality of weld formation in FSW according to the applied control system. Thus, this integrated system gives higher values to the end user in the FSW research field.

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