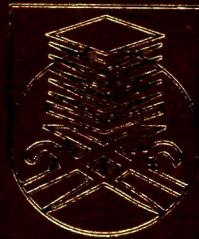# ACHIEVING ROBOTIC WELDING QUALITY ON SHIP PANEL STRUCTURE WITH OPTIMIZED DISTORTION AND MINIMAL DEFECTS USING FEA AND ADVANCED NDT

RESEARCH MANAGEMENT INSTITUTE (RMI)
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR
MALAYSIA

BY:

ASSOCIATE PROFESSOR DR.-ING.
YUPITER HARANGAN PRASADA MANURUNG
(IWE/EWE/SFI, LASER TECHNOLOGY, CSWIP RI, RT 1)

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(Naib Canselor UiTM)

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(Dekan Fakulti Kejuruteraan Mekanikal, UiTM)

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(Kay Marine Sdn. Bhd.)

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(ZL Technologies Sdn. Bhd.)

Mr. Ng Khek Tong
(ABB Malaysia)

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TABLE OF CONTENT

ABSTRACT

This E-Science project deals with a comprehensive investigation to achieve high welding quality which was conducted with the aid of fully automated technology, Finite Element Method (FEM), statistical Design of Experiment (DoE) and digital radiography. Principally, the research was divided into four (4) main parts. In the first part of the research, the effects of the clamping and welding sequence on distortion are to be observed. The distortion behavior induced by welding process with different clamping location and welding sequences was studied by using linear elastic and thermo-elastic-plastic FEM methods and the results were compared with the experimental verification using common industrial clamping. The best clamping position and the suitable welding sequences were selected based on simulation (linear and non-linear) and experiments for further investigation. In the second part, the application of robotic welding was observed to find the best parameters to join material with different thickness and geometry. Similar to the first part of the study, the investigation in the second part started with simple butt and T-Joint with thicknesses of 4 mm, 6 mm and 9 mm and with material of low Carbon steel. For further purpose, Welding Procedure Specifications were created . In the third part, the optimized welding parameters with minimum distortion and defects were investigated by using Design of Experiment (DoE). Optimization methods using Taguchi and Response Surface Methodology (RSM) were applied to develop the model for prediction purpose. Confirmation test was further conducted to prove the optimized model.

The research ended up in the fourth part with a development of an application tool named as "VIDERE Version 1" which can be applied to inspect the internal defects by using digital radiography. This stand-alone tool was developed by using image processing and GUI tools in MATLAB. By using this application tool, it is expected that the interpreter can be supported by using the elements of image processing, image quality and radiographic inspection report.