

**UNIVERSITI TEKNOLOGI MARA**

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

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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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# TABLE OF CONTENTS

	<b>Page</b>
<b>CONFIRMATION BY PANEL OF EXAMINERS</b>	i
<b>AUTHOR'S DECLARATION</b>	ii
<b>ABSTRACT</b>	iii
<b>ACKNOWLEDGEMENT</b>	iv
<b>TABLE OF CONTENTS</b>	v
<b>LIST OF TABLES</b>	ix
<b>LIST OF FIGURES</b>	x
<b>CHAPTER ONE: INTRODUCTION</b>	
1.1 Research Background	1
1.2 Problem Statement	2
1.3 Research Objectives	3
1.4 Scope and Limitations of Research	4
1.5 Significance of Research	5
<b>CHAPTER TWO: LITERATURE REVIEW</b>	
2.1 Friction Stir Welding	7
2.1.1 Working Principle	7
2.1.2 Microstructural View of Friction Stir Welding	8
2.1.3 Types of Material and Tool	9
2.1.4 Joint Configurations	10
2.1.5 Important Process Parameters	11
2.1.6 Type of Defects in Friction Stir Welding	12
2.1.7 Advantages and Limitations	13
2.1.8 Industries Application	14
2.2 The Importance and Effect of the Travel Speed on the Quality of Weld Formation in FSW Process	16
2.3 Relationship of the Weld Formation Temperature against Travel Speed in FSW Process	20

2.4	Feedback Control in Motion System	23
2.4.1	PID Controller	25
2.5	Motion Control System in FSW Process	26
2.6	Summary	28

### **CHAPTER THREE: METHODOLOGY**

3.1	Overview	30
3.2	Development of the Travel Control System	31
3.2.1	The Development of the Travel Control System GUI	31
3.2.1.1	Selection of Software and Hardwares	32
3.2.2	The Development of the Travel Control System Block Diagram	35
3.2.2.1	Event Handling Loop and Message Handling Loop	37
3.2.2.2	Acquisition Loop	42
3.2.2.3	Logging Loop	50
3.2.2.4	Data Display Loop	53
3.3	The Development of the Traverse Test Rig	56
3.3.1	System Functions and Requirements of the Traverse Test Rig	56
3.3.2	The Traverse Test Rig	57
3.3.3	Clamping System	59
3.3.4	Thermocouple Holder	60
3.4	The Development of the Integrated System	61
3.4.1	Calibration of the Traverse Test Rig	64
3.5	The Functional Verification Test	65
3.5.1	Open-Loop Control System Verification	65
3.5.1.1	Open-Loop Verification Using Heat Source	68
3.5.1.2	Experimental Setup	68
3.5.1.3	The FSW Experiment with the Implementation of the Integrated System	71
3.5.1.4	Data Collection and Analysis	75
3.5.1.5	Visual Inspection of the Welded Workpiece	76
3.5.2	Closed Loop Control System Verification	76
3.5.2.1	The System Integration Setup	77
3.5.2.2	PID Scheme: Parameter Selection	78