

AUTONOMOUS CONTOUR TRACKING INDUSTRIAL ROBOT USING  
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*To my mother, father, wife and sons, Napsiah, Saian , Sarihasmizan, Adam Yussuf  
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## ABSTRAK

Pelbagai kerja telah dilakukan untuk mengautomasikan proses pengesanan kontur ini untuk merealisasikan keupayaan pembelajaran sendiri. Pengesanan kontur tanpa sentuh mempunyai potensi dalam aplikasi pemasangan kaca kedap, kimpalan dan lukisan robotik. Dalam aspek ini, robot belajar permukaan kontur untuk menjejaki secara automatik. Walau bagaimanapun, salah satu masalah dalam teknik kontur ialah bagaimana untuk memperuntukkan sampel mengikut kerumitan keluk. Untuk keluk yang mudah, ia akan mempunyai titik sampel yang kurang, manakala yang lebih kompleks akan menjadi wakili oleh bilangan lebih banyak data. Dalam usaha untuk merealisasikan objektif tersebut di atas, analisis neuro fuzzy penjejakan kontur telah dibuat dalam kerja ini. Dua masukan dan satu keluaran ANFIS telah direka dan ia akan digunakan untuk memperbaiki kesilapan lengkung dan tahap ketidakstabilan. Terdapat lebih banyak data pada lengkung kompleks dan kurang titik pada lengkung mudah atau rata. Jika cerun tajam dan perbezaan antara kecerunan cerun yang terdahulu dan semasa adalah besar, maka ia mewakili keluk kompleks yang memerlukan bilangan lebih daripada titik pensampelan. Berdasarkan pertimbangan ini, 25 fuzzy rule telah dibuat dan menggunakan robot ABB revolute. Analisis menunjukkan bahawa pengesanan kontur menggunakan neuro fuzzy boleh memperbaiki pengesanan kontur yg lebih baik.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Project Introduction**

Industrial robot has widely been used in manufacturing and processes for many decades. Industrial robot is one of the most important for automated factory. It is the right choice for improving productivity and quality. Major applications of this second generation of robot are in the areas of arc welding, paint spraying, spot welding and some assembly. A simpler cost effective answer at reasonable method quality is proposed to untangle this drawback. Many industrial operations can be automated using robot manipulators such as in assembly and contour tracking processes. This project implies designing of sensible arrangement of sensor, study on Adaptive Neuro Fuzzy Inference System (ANFIS), fuzzy logic Sugeno type controller and ABB robot RAPID programming. Contour tracking methods also has been discussed in order meet the best result.

## 1.2 Problem Statement

Major applications of this second generation of robot are in the areas of arc welding, paint spraying, spot welding and some assembly [1]. Intelligent capability is limited only to sensory technology capability. (Camera and Pressure). The programming phase especially for contour tracking application is quite tedious and time consuming and for a complex contour, an example several series of three points must be taught, besides finding the optimum process parameter (voltage or current) related to those points. Therefore unnecessary noise points and error has occurred in actual contour tracking. ABB and Robot Studio is not PC based software, and it's run under RAPID programming language.

## 1.3 Problem Statement

An autonomous RAPID contour tracking program is needed to make robot TCP move and detect the work piece surface and produce crisp value. In order to study noise points and error analysis, this project implementing the Artificial Intelligent controller (NEURO-FUZZY or ANFIS) to approximate parameter, membership function and Fuzzy Inference System (FIS) rule. One of the key issues in manufacturing industry is contour tracking programming done manually for each workpiece or products. Teaching coordinate axis for each contour in term of create motion accordingly. In high production industry such as manufacturing and assembly, variation is limited whereby each robot only doing one process only. Those industries that deal with many types and variations of product these could cause them difficulties since many editing for robot programming are needed. This activity really time consuming and might contribute to downtime and losses [2].

## 1.4 Project Objective

This project aimed on empowering the ABB robot to learn contour tracking autonomously. First objective is to develop a cost effective solution and practical application to a process by using only one discrete proximity sensor attached for ABB revolute industrial robot. Secondly is to analyze and reduce any unnecessary noise points and error of the contour tracking method by applying Neuro Fuzzy. Neuro fuzzy in our case is used for fuzzy logic estimator to approximate the value of parameters for each inputs and output, to design membership function accordingly. Last but not least is to accommodate Neuro Fuzzy as an intelligent approach to improve the tracing accuracy and compare the differences, advantage and disadvantage between Neuro Fuzzy and conventional.

## 1.5 Scope of work

We start with ABB robot program development on contour surface using RAPID programming language for crisp method and implementing a unit discrete sensor for detection. Next is simulation on crisp data value in contour tracking using ANFIS/Fuzzy tool GUI in MATLAB software, this is done offline. To study basic knowledge of fuzzy logic, we had done few experiments using Sugeno type fuzzy logic just to find suitable two (2) inputs for ANFIS controller. Then we comparing result traced tracking between trained tracking result based on Mean Error and Standard deviation analysis. Inside ABB RAPID programming, we are planning to accommodate trained fuzzy inference system (FIS) and obtained the final contour tracking and wish to compare our own result from simulation analysis with new robot program tracking, also compare to different parameter and membership function

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