AUTONOMOUS CONTOUR TRACKING INDUSTRIAL ROBOT BY USING TYPE-2 FUZZY LOGIC

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ABSTRACT

This research is focusing on the improvement of the tracking method done for industrial robots by using On-Off method. The On-Off method is developed previously as a solution for the autonomous tracking method. The reason for improvement of the On-Off method is because the tracking error and deviation from targeted contour is exceptionally large. Improvements are done by using Artificial Intelligence methods which are Type-1 and Type-2 Fuzzy Logic Systems. The mean error and standard deviation for the tracking has been suppressed. This includes the improvement of the tracking time efficiency for the whole contour. The industrial robot selected to perform the actual tracking motion is the ABB Revolute Robot IRB1410 with 6 degree of freedom. It is to represent the realistic condition of the industrial and the real world application. For the sensor, a proximity photoelectric sensor diffused type is used for contour surface detection signal. It is chosen for its versatility in detecting any type of material used for the targeted contour surface.

ABSTRAK

Kajian ini memberikan tumpuan dan fokus kepada pembaikan kaedah “On-Off” untuk pengesanan dan penjejakan kontur oleh robot industri. Kaedah “On-Off” telah di reka pada masa lalu untuk penyelesaian kepada kaedah pengesanan kontur secara autonomi. Tujuan untuk penambahbaikan kaedah itu adalah kerana kesilapan pengesanan dan penyimpangan dari sasaran kontur adalah dikira sebagai besar. Penambahbaikan dilakukan menggunakan kaedah Kepintaran Buatan iaitu menggunakan ”Type-1 and Type-2 Fuzzy Logic Systems”. Ralat min dan sisihan piawai untuk mengesan telah dikurangkan. Ini termasuk peningkatan kecekapan Penjejakan masa untuk kontur keseluruhan. Robot perindustrian yang dipilih untuk melaksanakan gerakan pengesanan sebenar adalah ABB Revolute Robot IRB1410 dengan 6 darjah kebebasan. Ia adalah untuk mewakili keadaan yang realistik aplikasi dunia industri yang sebenar. Untuk penggunaan sensor, sensor jarak fotoelektrik jenis tersebar digunakan untuk pengesanan isyarat kontur permukaan. Ia dipilih kerana serba boleh dalam mengesan sebarang jenis bahan yang digunakan untuk permukaan kontur yang disasarkan.

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CHAPTER 1

INTRODUCTION

Many industries nowadays are changing from manual human operators to automation in their operation. The automatic control and industrial robotics are some examples of automation. Industrial operation has become automated by using industrial robot that is used in the assembly and contour tracking process. This reduces process cycle time and increases efficiency.

In a robotic application, it consists of contact and non-contact operations. An example of contact application is in the assembly process that requires the manipulation of work piece position and orientation. This can be seen in the pick and place activity in a factory or plant.

For the non-contact application, examples are such as gluing glass panel and the painting process which requires contour tracking but with gaps between the tool tip and target. The focus of this research will be on non-contact contour tracking.

1.1 Project Objectives

The first objective is to program the crisp (On-Off) method in order to do surface contour tracking for the ABB revolute industrial robot.

The second objective is to improve and reduce any unnecessary ‘noise points’ of the crisp contour tracking method by applying Fuzzy Logic Inference system for the controller.

Thirdly, it is to compare and discuss on the differences, advantages and disadvantages between On-Off, Fuzzy Logic, and Fuzzy Logic Type-2 approach for the contour tracking.

1.2 Scope of Project

Current practise in most of the industry or factory for the robot is by using teaching pendant for tracking and movement. The problem with teaching pendant is that the teaching process of the teaching pendant is time consuming and not flexible. In order to track a simple arc, three points are required. But the actual application requires tracking different shapes. Therefore for a more complex curve, more points are needed. To make things worse changing to another type of curve requires starting the teaching process again.

To solve the problem, autonomous contour tracking algorithm will be developed. Fuzzy logic controller will be used for the tracking control method. Fuzzy logic has the capability of converting linguistic control strategy based on expert knowledge into an automatic control strategy. Fuzzy logic Type-2 is discussed as having more accurate tracking process compared to Fuzzy logic Type-1.

A problem that might occur for autonomous surface tracking algorithm is that the difference between complex and simple flat curves cannot be determined. The difference between complex and simple flat curve cannot be determined.

The same tracking distance for the whole contour plane produces low tracking time efficiencies. The flat surface should be tracked faster than high gradient curves. This will also reduce the error and noise generated for flat contour tracking will be reduced.

1.3 Methodology

The industrial robot used for the research is ABB revolute robot with 6 degree of freedom. The program of the crisp on-off method algorithm is developed for the contour tracking. The value and data from the crisp method is used as input data for the Fuzzy Logic Controller. The sensor used is of the photoelectric type that has exceptional range and accuracy.

2 Type-1 fuzzy logic controllers are designed particularly to solve the flat surface and complex (steep) curve problems separately. Then they are embedded in the Type-2 controller as used in the research.

The fuzzy logic Type-2 algorithm will be produced for determining the sampling horizontal distance, dx. By controlling dx, the fuzzy logic decides; that more samples on the complex curve and less for the flat curve. It is capable of improving the tracing accuracy and reducing noise points in the flat curve. It can also improve the time efficiency of the tracking process.

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