

# The Design and Practical Study of a Smart Wiper System

王文廷、張舜長

E-mail: 9224879@mail.dyu.edu.tw

## ABSTRACT

The main factor that affect safety-driving is the clear grade of windshield. In the tradition wiper system, the driver needs to adjust wiper according to the rainfall. It is easy to cause driver distract. In this study, we use infrared light reflection to sense whether there is rain falling on the windshield, and describe the development of auto-wiper system using a fuzzy logic controller and look-up table controller. This system can automatically adjust wiping speed according to the rainfall. The satisfactory results of experiments obtained by using the fuzzy control method and look-up table control method.

Keywords : Wiper , Rain Sensor , Fuzzy Control

## Table of Contents

|                                    |                             |                             |   |
|------------------------------------|-----------------------------|-----------------------------|---|
| 第一章 緒論 .....                       | 1 1.1研究背景 .....             | 1 1.2研究動機與目的 .....          | 2 |
| 1.3文獻回顧 .....                      | 3 1.4研究步驟 .....             | 5 1.5論文架構 .....             | 7 |
| 第二章 系統描述 .....                     | 8 2.1雨刷機構基本構造 .....         | 8 2.2智慧型雨刷系統控制策略與結構 .....   |   |
| .....10 2.2.1系統控制策略 .....          | 10 2.2.2雨滴感知器構造及原理 .....    | 13 2.2.3車速和擋風玻璃上雨水之關係 ..... |   |
| .....16 2.3雨刷實驗平台 .....            | 19 2.3.1實驗儀器與設備 .....       |                             |   |
| .....21 2.4擋風玻璃之視線模糊分析 .....       | 25 2.5雨刷動作和雨滴感知器特性之關係 ..... |                             |   |
| .....28 第三章 控制器設計 .....            | 32 3.1模糊邏輯控制器 .....         | 32 3.1.1模糊控制簡介 .....        |   |
| .....33 3.1.2模糊控制理論 .....          | 34 3.1.3模糊控制器之設計 .....      | 37 3.1.4模糊控制實驗結果 .....      |   |
| .....42 3.2建表法控制器 .....            | 49 3.2.1建表法控制理論 .....       |                             |   |
| .....50 3.2.2馬達轉速和雨量、驅動電壓之關係 ..... | 53 3.2.3建表法控制器實驗結果 .....    |                             |   |
| .....57 3.3實驗結果分析 .....            | 64 第四章 結論與建議 .....          | 66 4.1結論 .....              |   |
| .....66 4.2建議 .....                | 67 參考文獻 .....               | 68                          |   |

## REFERENCES

- [1] K. C. Cheok, K. Kobayashi, S. Scaccia, and G. Scaccia, "A Fuzzy Logic-Based Smart Automatic Windshield Wiper," IEEE Control Systems Magazine, pp.28-34, 1996.
- [2] M. Ucar, H. M. Ertunc, O. Turkoglu, "The Design and Implementation of Rain Sensitive Triggering System for Windshield Wiper Motor," Electric Machines and Drives Conference, 2000. IEMDC 2001, pp.329-336, 2001.
- [3] O. Terakura, A. Kurahashi and S. Wakabayashi, "Development of Rain Sensor for Automatic Wiper System," SAE Paper, 2001-01-0612.
- [4] K. Mori, Y. Shiraishi, and M. Kuribayashi, "An Intermittent Wiper System with a Raindrop Sensor," SAE Paper 851637.
- [5] N. Cappetti and E. Santoro, "An Application of Visualisation for Solving a Mechanical Design by Fuzzy Set," IEEE Control Systems Magazine, pp.79-88, 1996..
- [6] V. Nikanth, "Finite Element Analysis of Metal Canned Wiper Design," SAE Paper 931170.
- [7] M. Y. Ghannam and M. R. Schumack, "Analisis of an Automotive Windshield Washer Fluid Delivery System," SAE Paper 2001-01-0128.
- [8] Y. K. Chin, A. Kade , J. Kowalik and D. Graham, "Electronic windshield wiper system :modeling and validation," Int. J. of Vehicle Design, vol. 12 , no. 2, pp.175-182,1991.
- [9] Y. K. Chin, A. Kade , J. Kowalik and D. Graham, "Electronic windshield wiper system :control and sensitivity study," Int. J. of Vehicle Design, vol. 12 , no. 2, pp.183-196, 1991.
- [10] 彭毓瑩 , "雨刷機構創新與合成" , 清華大學 , 碩士論文 , 2002。
- [11] B. S. Hsu and S. F. Ling, "Windshield Wiper System Design," Int. J. of Vehicle Design, vol. 11 , no. 1, pp.63-78 1990.
- [12] 徐碧生 , "轎車雨刷系統設計"台灣工業技術學院 , 碩士論文, 1985。
- [13] 黃明耀 , "轎車雨刷之彈性動態分析"成功大學 , 碩士論文 , 1983。
- [14] L. X. Wang, "A course in Fuzzy Systems and Control", 1997.
- [15] 黃靖雄、賴瑞海 , 汽車學(汽車電學篇)全華科技圖書 , 1990。

- [16] 孫宗瀛、楊英魁，"Fuzzy控制:理論、實作與應用"全華科技圖書，台北，1999。
- [17] 孫宗瀛、楊英魁、鄭魁香、林建德、蔣旭堂，"模糊控制理論與技術"，全華科技圖書，2001。
- [18] 李書橋、林志堅，"汽車感測器原理"，全華科技圖書，民國80年。
- [19] 王文俊，"認識FUZZY"，全華科技圖書，2000。
- [20] 王進德、蕭大全，"類神經網路與模糊控制理論入門"，全華科技圖書，民國91年。
- [21] 楊英魁、中國生產力中心技術服務組，"FUZZY 控制"，全華科技圖書，民國82年。
- [22] 施慶隆、李文猶，"機電整合與運動控制-原理與單軸平台實驗"，高立圖書有限公司，民國86年。
- [23] Advantech, "PCL-818L High-performance DAS card Use's Manual".
- [24] 黃英哲，"控制系統模擬"，五南圖書出版有限公司，民國89年。
- [25] 劉勝治，"圖控式程式語言LabVIEW"，全華科技圖書，1999。
- [26] 蕭子健、儲昭偉，"LabVIEW進階篇"，高立圖書有限公司，1999。