

# 以FPGA為基礎之智慧型巡航控制系統設計與實現

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## 摘要

在智慧型運輸系統(ITS)中的先進車輛控制與安全系統裡，適應性導航控制(ACC)系統扮演著一個相當重要的角色。當前方有車輛時，ACC系統會自動進入跟車模式，跟隨前方的車輛並保持一定的安全距離；當前方沒有車輛時，ACC系統會自動切換到定速模式，以一個預定的速度行駛。我們利用模糊理論來設計智慧型巡航控制器。利用模糊理論的好處在於不需要知道複雜非線性的車輛動態模型。首先將控制器分為兩個部分：第一個部份是當前面有車輛時，會根據目前的相對距離來決定車輛應該操縱在那一種模式，而且可以自動切換於跟車與定速兩種模式；第二個部份是當前面沒有車輛時，根據目前的車速來決定加、減速多少以保持設定的車速，或者當前面有車時，我們根據目前的相對速度與相對距離來決定加、減速以保持一安全距離。

本文將利用FPGA來驗證智慧型巡航控制器之可行性，雖然實現上較為複雜、困難，但是它比車用電腦更便宜、更省體積，因此更適合用於車輛控制，除此之外，根據實驗結果顯示，所提出以模糊理論為基礎的控制器可以提供一個安全與舒適的行車輔助駕駛系統。

關鍵字：智慧型運輸系統、FPGA、模糊控制、定速巡航、適應性巡航、

智慧型車輛

# Design and implementation of an FPGA-based Intelligent Cruise Control System

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## Abstract

Adaptive Cruise Control (ACC) System is an important part of the Advanced Vehicle Control and Safety System (AVCSS) in Intelligent Transportation Systems (ITS). In this thesis, we design an ACC controller for following a leading vehicle to achieve the desired safety distance, or cruising at the pre-selected speed when there is no vehicle in front of us. We design an intelligent cruise controller with fuzzy theory. The advantage of using fuzzy theory is that it doesn't require the complete knowledge of nonlinear vehicle dynamics, and it can be applied to vehicle regardless of its nonlinear or unobservable dynamics. We separate the controller into two parts. The first part is used to determine which mode the controller should take according to relative distance. Besides the controller can switch between car following and cruise control automatically. The second part is when there is a vehicle in front of us the controller should accelerate or decelerate to keep the safety distance according to relative speed and relative distance or when there are no cars in the same lane the controller can accelerate or decelerate to hold a desired speed according to the target speed and real-time speed.

In the thesis we try to implement the intelligent cruise controller with FPGA (without car computer). Although it is more complex to realize, it is not only smaller but also cheaper. Hence it is appropriate to be used in vehicles and to be promoted.

Through this thesis we will prove that the intelligent cruise controller, which is built on FPGA, will provide a safe and comfortable driving assistance system for drivers.

**Keywords :** Intelligent Transportation Systems (ITS) 、 FPGA 、 fuzzy logic control 、 cruise control (CC) 、 adaptive cruise control (ACC) 、 Intelligent vehicle

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