

國立交通大學

資訊科學與工程研究所

博士論文

視覺式車輛特徵分析之研究

Research on Vision Based Car Feature Analysis

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中華民國一百零一年七月

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## 摘要

由於交通監控系統的普及化，偵測、追蹤並且辨識道路影片中的移動物體，逐漸成為一項重要的研究議題。由於大部份的事故是由汽車所引起的，而且車輛的外型特徵相較於車牌號碼，更不易被偽造或者隱藏，因此本論文將建構一個智慧型交通監控系統，能夠在各種攝影機角度、各種反光影響下，辨識車輛的外型特徵，包括顏色、大小與款式。為了克服光影的變化，排除車窗、車燈等無關車色像素的影響，本論文提出一個三階段車體切割演算法，分別針對亮色系、暗色系與彩色系的車子，設計不同策略切割車體，車輛的顏色僅考慮車體內部像素，因此可以得到更精準的車輛主顏色，更進一步得到更正確的車色分類結果。為了快速地估計車輛大小以及旋轉角度，本系統提出對稱中心演算法，用來搜尋車頭的對稱中心，並計算此中心到最近邊緣的距離，此距離與車輛高度以及寬度的比例，分別與車輛的大小與角度呈現單調函數，因此車輛的大小與角度可藉由比例的反函數來求得。為了在各種角度下更精準的辨識車款，我們提出鏡射形變技術，此技術可將在各種角度下拍攝到的車子都調整成標準的正面、側面或者背面，接著選擇與測試車相同角度，並同樣經過形變處理的樣本車來比對。由於鏡射形變技術可有效地排除角度估計誤差以對稱中心搜尋誤差，因此能比傳統以角度估計為基礎的車款辨識方法提供更高的正確率。

關鍵詞：車輛顏色識別、車輛大小分類、車輛角度估計、車輛款式辨識、智慧型交通系統、三階段車體切割、鏡射形變

# Research on Vision Based Car Feature Analysis

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## Abstract

With the rapid growth of surveillance equipments, detecting, tracking, and recognizing moving objects in roadway videos is currently a popular issue. Because most accidents are caused by cars and the appearance features of cars are hard to be hidden or counterfeited like license plate, this research develops an intelligent traffic monitoring system which identifies appearance features, such as sizes, models, and colors under varying camera viewpoint and light reflections. Due to the effect of non-homogeneous light reflection, the improper foreground pixels, such as the windshield, or lamps influence the extraction of color type. A tri-states car body segmentation algorithm is proposed in this dissertation. Different strategies are designed for bright, dark, and colored cars, and only the pixels belonging to the car body are considered for color classification. Therefore, a purer car color can be extracted and a more correct color type can be classified. To rapidly estimate the size and pose of a car, a symmetric center detection algorithm is proposed. The algorithm searches the symmetric center on the head (or rear) of a car and computes the distance between the center and the closest boundary as half of the head width. Two aspect ratios: car height to head (or rear) width and head (or rear) width to car width, are designed to identify the car size and car pose.

To recognize car model across varying poses, a mirror morphing scheme is proposed. The scheme is able to transform cars with varying poses into a typical (front, rear, or side) view. Then a template car with the same pose with the tested car is selected and matched against the tested car. Because the mirror morphing scheme effectively reduces center bias and estimation error of tested and template cars, higher recognition rate can be anticipated. Finally, the experiments show that the proposed system is superior to conventional approaches for classifying colors, sizes, and models of cars.

Keywords : car color determination, car pose estimation, car size classification, car model recognition, intelligent transportation system, tri-states car body segmentation, mirror morphing

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## 誌謝

### Acknowledgement

這一篇論文得以完成，我要特別感謝恩師 李素瑛教授。因為有老師如慈母般的關懷，我才能堅定地完成研究，在她的費心指導下，論文品質才能有所提升。碩士班兩年以及博士班五年的時間，跟隨在老師身邊，感謝她的呵護、包容、鼓勵以及引導，讓我無論在待人處事、治學研究上都獲益良多，李老師是我學習的典範、一生模仿的對象。

感謝所有口試委員，范國清老師、廖弘源老師、張隆紋老師、吳坤榮老師、莊榮宏老師以及杭學鳴老師，老師們所給予的建議與指導，充實了本論文的深度與廣度，更幫助我對學術研究有更寬廣與深刻的體會。

此外我也要感謝多媒體資訊系統實驗室的學長姐以及學弟妹們，在每周開會的討論當中，我們一同成長，精益求精。更要感謝與我一同完成中華電信研究所計畫的學弟妹們，雋杰、立武、億才、端賢、誠毅與姿延，討論到深夜的景況歷歷在目，都是我珍貴的回憶，因為有你們的陪伴，讓我的實驗室生活豐富而精采。

最後要感謝我親愛的父母親，古錦安博士以及許瑞容女士，因為有他們的支持，我才能安心無慮地完成我的研究。感謝我的弟弟侑弘，他理解我遭遇研究瓶頸時的憂慮，不斷給我加油打氣。更要感謝和我一起完成博士學業的先生 永威，在求學的路上，我們共同承擔博士班生涯的酸甜苦辣滋味，也協助我激發出許多的創意與靈感，突破研究的困境。心中有太多的感謝想要表達，謹將此論文獻給研究路上支持我、陪伴我的每一個人，謝謝。