車輛定位系統

An Innovative Vehicular Positioning System

張哲誠　姚文盛　嚴毅

財團法人車輛研究測試中心 資通訊技術專案室

摘要

在本篇論文中，我們提出一套新穎的車輛定位系統的概念，該系統的目標在於提升車輛定位系統的準確性以及穩定性。因為在某些情境下，全球定位系統會發生資訊中斷以及多重路徑的影響，導致定位系統的定位資訊的精度及穩定度不足，而導致無法應用於某些特定的場景。因此，為了提升改良傳統 GPS 可能遇到的問題，我們提出一些新的概念，讓定位系統能夠持續穩定地輸出高精度的定位資訊。該系統的概念是整合多種感測資訊，除了原先的 GPS 訊號，也加入慣性感測器、輪速計以及環境特徵點偵測的功能。由於部份新出廠的車輛已預先搭載慣性感測器及輪速計，因此本系統將不需要太多額外的成本即可建置完成。

Abstract

In this paper, we propose a novel concept of the vehicular positioning system, which aims to enhance not only the accuracy but also the reliability of vehicle positioning information. Since outages and multi-path appearance of global positioning system signals occur in some situations, it is obvious that information of global positioning system is not always accurate and reliable. Thus, in order to correct above mentioned problems, we incorporate several innovative ideas with traditional architecture to keep reliable positioning information available. To be specific, our vehicular positioning system integrates several different sensing technologies, including global positioning system, inertial measurement unit, odometer, and environment feature detection and recognition. The system can help vehicles obtain more accurate and reliable vehicular positioning information. As many new vehicles have pre-installed some of these sensors prior to sales, this means that our vehicular positioning system may not induce much additional cost.

關鍵詞：車輛定位系統、感應器、資訊融合演算法

Keywords：Vehicular Positioning System、Sensor、Data Fusion Algorithm

Introduction

Vehicle is one of the most used transportations for people nowadays. Road safety has been an important topic during the past few years. Vehicular passive safety has been undergoing many developments, resulting in mitigated a lot of traffic accidents. To further reduce traffic accidents and enhance convenience with regard to vehicles, many advanced assistant safety techniques have been developed for various scenarios, e.g., lane departure warning system [1], forward collision warning system [2], blind spot warning system [3], parking assistant system [4-7] and navigation [8-9]. Thus, vehicular assistant safety systems have become more and more indispensable for up-to-date vehicles.

Consider those above mentioned assistant safety systems, some need absolute positioning information, and some positioning information relative to other objects. For absolute positioning information, there have been many researches intend to enhance the reliability and accuracy of global positioning system (GPS) [10-15], e.g., the authors in [10] design the inertial navigation system (INS) to complement the reliability and accuracy of the navigation system. Because GPS has long-term stability and inertial measurement unit (IMU) short-term stability, the integration of GPS and IMU provides a complete navigation solution with higher data rate. However, it will lead to lots of residual drifts if inertial sensor biases are not well estimated.

In this paper, we propose a novel concept of vehicular positioning system, which aims to enhance not only the accuracy but also the reliability of vehicle positioning information. More specifically, our vehicular positioning system is implemented via different sensing technologies, that is, GPS, IMU, odometer and environment feature detection and recognition. By incorporating these sensing technologies, the vehicular positioning system can fuse distinct sensing information to make the optimal positioning information according to different scenario. Thus no matter where the vehicle is, our vehicular positioning system can steadily provide optimal positioning information.

This paper is structured as follows. In the second section, we first describe the preliminaries of those incorporated technologies briefly, e.g., GPS, IMU, odometer and environment feature detection and recognition. Particularly, there are two parts in the second section, the former shows the absolute positioning information and their corresponding usage, and the latter describes the positioning information relative to other reference points and their corresponding usage. In the third section, we start to introduce the architecture of our vehicular positioning system, including the preliminary idea of