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Introductory Chapter: Life Improving Advances in Navigation Systems

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Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/intechopen.82112>

1. Introduction

Navigation systems are a study field that focuses on the process of monitoring and controlling the movement of an entity from one place to another. General, navigation systems may be entirely on board an entity, or they may be located elsewhere and communicate via radio or other signals with an entity, or they may use a combination of these methods. It means that navigation systems can refer to any skill that involves the determination of position and direction compared to known locations or patterns and, simultaneously, navigation strategies can include several general categories varying in the environment and navigator's substance. The book "Navigation Systems" provides a platform for researchers, academics, PhD students and other scientists to review, plan, design, analyze, evaluate, intend, process and implement diverse issues of navigation systems. Topics of this book include some new methods, approaches and algorithms for applications in human and machine navigation systems. Five book chapters demonstrate capabilities and potentialities of navigation systems to solve scientific and engineering problems with a varied degree of the complexity. The first two chapters related to satellite navigation systems provide details of high-precision dynamic location and airborne double-antenna orientation approach. The second three chapters associated with human navigation systems demonstrate possibilities of utilizing modern technologies in navigation systems with the aim of helping common users and physically and/or visually impaired persons.

2. Advances improving satellite navigation systems

In the first part of the book, chapters are dedicated to improving functionalities of satellite navigation systems. A focus on characteristics of GPS and Beidou satellite navigation systems

is interesting, especially when time and coordinate systems are utilized. For improving a receiver's accuracy, a high-precision dynamic localization can be considered in conjunction with an improved dual-mode positioning algorithm of the star selection and an optimal location algorithm. In order to solve a localization problem, an interesting solution can be applied to an approximate linearization system. For possible single-mode and dual-mode systems, requested equations for the filter should be prepared. It must be expected that a satellite navigation system composition is under composition and an improved algorithm is simulated and verified by the software. A positioning method of the dual-mode location and star selection can not only guarantee a positioning accuracy, but it should also improve system efficiency. Then, a design of the dual-mode navigation and positioning system can be advantageous.

When GPS and BeiDou satellite navigation systems are used for determining a course angle of the aircraft, then a focus on antenna orientation methods is interesting. The idea that global satellite navigation systems can not only provide the information in terms of location and time, but also the course angle of its carrier through processing of multiple antennas and specific data, can be considered. It is useful to utilize its advantages of none accumulative errors and its high orientation accuracy. For this reason, an observation model of satellite navigation systems can be established for proposing orientation methods. It must be emphasized that any suggested resolution method of the carrier phase must be analyzed through a depth study. Also in this case, combined orientation and directional algorithms should have been verified in preference by the simulation program and hardware platform experiments.

3. Life improving advances in human navigation systems

In the first part of the book, chapters are oriented on advances in modern technologies improving various real life's aspect of populations. A walking support system that takes into account each user's health conditions, needs and preferences is a real possibility for utilizing of navigation systems by common users. The eventual system can be developed by integrating different partial systems into a single system. From a viewpoint of active users, it is very important to establish and conduct an interactive feedback. Based on the web questionnaire survey, the system usefulness can be increased for selecting a walking course. It is evident that the system should be used by different types of information terminals approximately in the same way. And, a system operation must be evaluated according to the purpose of effectively supporting users' walking activities. I hope that a functional and confirmed walking support system will be successfully widespread also in many cities and/or countries.

A development of appropriate navigation systems for visually impaired persons that are relying on guide canes in order to walk outside for avoiding any obstructions or hazardous situations is very important. Therefore, a tactile pavement detection system used the image recognition can be considered to advantage. Of course, some experiments must be conducted for detecting the tactile pavement and for identifying the shape of tactile patterns. For better proposal, the software environment including a special platform as guidance tools can be utilized. For notifying visually impaired persons, accurate auditory outputs must be included.

A development of the tactile pavement detection system can be prospective for easily detected and navigated purposes of serving for visually impaired persons.

Also utilizing of navigation systems specialized for a pipeline industry can lead for life improving. From a viewpoint of surrounding environments and a safety of civilian's lives, it is important to eliminate negative influences of potential pipeline leakages. And from these reasons, an attention should be focused on a pipeline inspection gauge that could accomplish a variety of pipeline defects. Because inspections should be executed effectively, then these defects must be localized precisely by installing various detecting and positioning sensors. So, a proposal of relevant navigation systems can be prepared application mechanisms with advanced position methods researched for improving the overall positioning precision. With regard to demands, proposed methods and research conclusions are expected to be verified by simulation experiments using the indoor wheel robot platform and appropriate experiments.

I hope that beginners and professionals in the field would benefit by going through details given in these chapters of the book.

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