



COST EFFECTIVE NAVIGATION OF AUTONOMOUS UNDERWATER VEHICLES

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Abstract

Navigation is a highly challenging aspect of an autonomous vehicle's operation. For autonomous underwater vehicles, this becomes even more difficult due to the complexities of the underwater environment and the restricted availability of GPS signals. Amidst the variety of navigation methods that are commonly used for underwater navigation, inertial navigation is the most self-contained. Until recently, the high cost of inertial navigation systems did not allow for their use by small to medium enterprises, but the advent of low cost inertial navigation systems has recently made this technique a more pragmatic option for inexpensive projects.

These devices however, have their limitations, with inherent errors that accumulate with time. While manufacturers publish the accuracy of inertial navigation device's internal components (such as accelerometers, gyroscopes and magnetometers), it is not immediately evident how these figures directly affect navigational accuracy because of compensation strategies between these components.

This study empirically demonstrates the practical performance of a commercially viable inertial navigation system, analyses the observable errors and assesses strategies for performance enhancement, such as by using Kalman filters to combine data from other devices.

For reasons of practicality, the experimental studies were principally undertaken using a land vehicle that followed particular pathways from which the accuracy of the inertial navigation could be easily determined. Finally, underwater experimental trials were conducted to evaluate the performance of the low cost inertial navigation system underwater.

This thesis also demonstrates the achievable range of performances using devices with particular specifications. It is concluded that even though commercially affordable inertial navigation systems alone are not reliable, they can form a reliable core of navigation systems when they are aided by other devices via a Kalman filter, various architectures of which are also presented in this thesis.

Statement of Originality / Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide.

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