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TOWARDS LOW COST REAL-TIME SEAFLOOR FEATURELESS VISUAL ODOMETRY

BY

JORDAN W. BEASON

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE OF

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MASTER OF SCIENCE THESIS

OF

JORDAN W. BEASON

APPROVED:

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DEAN OF THE GRADUATE SCHOOL

UNIVERSITY OF RHODE ISLAND

2023

ABSTRACT

Navigating the underwater environment is a challenging task for modern visual odometry algorithms due to poor visibility and a lack of distinct points for feature-based match making. This research increases the navigation capability of undersea vehicles via the adoption of a more robust, featureless image registration algorithm for visual odometry. Featureless image registration utilizes the frequency domain in order to match images based on their cross power spectrum, and therefore does not require distinct feature points. As such, this method displayed reliable matching in environments with low texture, improper lighting, high contrast, and high texture, and has a consistent computational cost capable of real-time use on low cost systems such as the raspberry pi 4B+ microcomputer. In addition, low cost camera technologies were also utilized to demonstrate their ability to reduce barriers to entry for autonomous ocean research. Results demonstrated satisfactory velocity estimation and reliable altitude measurements utilizing calibrated stereo cameras. The proposed method builds off a number of works encouraging the use of featureless based image registration algorithms in the undersea environment as opposed to more traditional algorithms, and opens up avenues for future work in enhanced localization capabilities for undersea vehicles.

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Content has been removed as thesis contains CUI.