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Autonomous Underwater Vehicles Inspection Management: Optimization of Field of View and Measurement Process

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Keywords: Autonomous Underwater Vehicle, Management, Sensors, Condition Monitoring System, Optimization, Path Planning.

1 Introduction

Autonomous underwater vehicles are robots capable of operating in deep oceans. They can employ novel sensor payloads to optimise the route and the measurement process in hard-to-reach areas. Their technologies have advanced in recent years, increasing the application fields and overall capabilities. The absence of human control and their autonomy require new control algorithms and improvement in their positioning. It leads to optimisation of the inspection and control path planning. Several authors analyse path planning and optimal route development without taking into account measurement parameters. This paper proposes an analysis of the camera, or sensor field of view, determined by technical specification of the equipment and conditions set by the operators. The optimal combination of the principal variables is performed through comparison between different cameras used in industrial inspections. It also analyses the quality of the measurement, highlighting the role of ground instantaneous field of view as key factor in the optimal selection of operational conditions. It shows optimal exploitation of sensor payload and underwater vehicles in path planning, independent of the application field, vehicle, camera or sensor.

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2 Objectives

The aim of this article is to highlight the main concepts for marine inspection and developing an analysis methodology to increase the reliability of underwater inspection. The optimisation of AUV path planning is possible with the study of fundamental variables in the underwater data acquisition. Operator can consider an optimal combination of measurement variables in order to optimize AUV mission. The novelty proposed in this article is the study of the measurement process from the sensor or camera point of view, taking into account that this is a critical task in reliable seafloor measurements.

3 Methods

Field of View (FOV) is the area covered by camera or sensor, depending to its technical specification. It is defined by large number of variables and calculated regarding on trigonometric positioning. This paper considers variables controlled by operators in order to simplify this problem. It is considered as restrictions the maximum AUV depth due to its specifications and the estimate size of the defect selected by the operators. It is introduced the Ground Instantaneous FOV (GIVOV), that shows the size of one single pixel at the depth selected in centimeters or area unit is introduced (Kwasnitschka et al., 2016b).

4 Results

GIFOV value is calculated regarding the depth (see Figure 5). GIFOV variation increases for higher values of depth, highlighting the importance of determine efficiently this value, despite of the fact that ground resolution of each camera (C1-C4) is similar. Depending on the type of operation and conditions, it is possible to choose optimal values to ensure the FOV maximization.

5 Conclusion

Underwater measurement processing has been analysed taking into account the area measured regarding on the technical specification of the camera or sensor. Field of view is defined regarding to the main different parameters involved. Four industrial cameras with the aim of probing the reliability of the proposed method are compared. These cameras have different specification, rendering possible the installation of this model in any type of operation. Ground instantaneous field of view is the operational restriction to define the optimal type of camera, orientation of depth, etc.

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