Drones • *Open Access* • Volume 7, Issue 2 • February 2023 • Article number 133

Document type
Article • *Gold Open Access* • *Green Open Access*

Source type
Journal

ISSN
2504446X

DOI
10.3390/drones7020133

Publisher
MDPI

Original language
English

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An Automatic Visual Inspection of Oil Tanks Exterior Surface Using Unmanned Aerial Vehicle with Image Processing and Cascading Fuzzy Logic Algorithms

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Abstract

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Abstract

This paper presents an automatic visual inspection of exterior surface defects of oil tanks using unmanned aerial vehicles (UAVs) and image processing with two cascading fuzzy logic algorithms. Corrosion is one of the defects that has a serious effect on the safety of the surface of oil and gas tanks. At present, human inspection, and climbing robots inspection are the dominant approach for rust detection in oil and gas tanks. However, there are many shortcomings to this approach, such as taking longer, high cost, and covering less surface area inspection of the tank. The purpose of this research is to detect the rust in oil tanks by localizing visual inspection technology using UAVs, as well as to develop algorithms to distinguish between defects and noise. The study focuses on two basic aspects of oil tank inspection through the images captured by the UAV, namely, the detection of defects and the distinction between defects and noise. For the former, an image processing algorithm was developed to improve or remove noise, adjust the brightness of the captured image, and extract features to identify defects in oil tanks. Meanwhile, for the latter aspect, a cascading fuzzy logic algorithm and threshold algorithm were developed to distinguish between defects and noise levels and reduce their impact through three stages of processing: The first stage of fuzzy logic aims to distinguish between defects and low noise generated by the appearance of objects on the surface of the tank, such as trees or stairs, and reduce their impact. The second stage aims to distinguish between defects and medium noise generated by shadows or the presence of small objects on the surface of the tank and reduce their impact. The third stage of the thresholding algorithm aims to distinguish between defects and high noise generated by sedimentation on the surface of the tank and reduce its impact. The samples were classified based on the output of the third stage of the threshold process into defective or non-defective samples. The proposed algorithms were tested on 180 samples and the results show its superiority in the inspection and detection of defects with an accuracy of 83%. © 2023 by the authors.

Author keywords

automatic visual inspection; camera; fuzzy logic; oil tank; unmanned aerial vehicle

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Funding details

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