Brightness measurement of ships navigation at night based on color CCD camera

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Digital image photographed by color camera

Overview: With the continuous improvement of the industrialization and urbanization of human society, the light pollution at sea was increasingly affecting the safe navigation of ships at night. In order to better measure the light environment of ships navigation at night, and evaluate the light environment to reduce the impact of light pollution at sea upon ships navigation at night. Making foundation for the safety of the ship's night navigation and laying the foundation for the urgent need to choose a measurement tool to measure light pollution at sea. Aiming at the limitations of current light environment measurement tools, this paper proposes a method of using color CCD camera in combination with digital image processing technology to measure the brightness of the sea light environment. Firstly, starting from the principle of a color CCD camera, combining photometry and colorimetry the theoretical theory analyze the feasibility of measuring brightness and determine the photometric parameters that need to be corrected. Secondly, the relationship between brightness and camera parameters was derived based on the principle of camera imaging. The digital image processing software was used to extract the brightness and color information from photos. The Chroma calibration experiment fits the relationship between the tristimulus value of the digital image and the standard RGB. The luminance calibration experiment fits the unknown parameters in the relational expression and then determines the luminance measurement formula. Finally, the measurement formulas of the waters of the Dalian Xingang oil tanker terminal are validated by examples. For a wide range of water CCD camera shooting, in order to avoid the occurrence of a large measurement error, the captured images are divided into regions. These regions are subjected to brightness and chromaticity calibration experiments, and the brightness of each region is measured separately. The brightness values obtained by the standard brightness meter and the color CCD camera were compared and analyzed. According to the analysis results, comparing the accuracy of the domestic standard luminance meter, the error of the method meets the standard of the second luminance meter and is close to the standard of the first luminance meter. The results show that this method is feasible for measuring the light environment brightness of the ships navigation at night exhibiting high accuracy. This method can be used not only to measure the nighttime light environment of ships in port waters but also to measure the brightness values of offshore light environments in other areas such as fishing areas and marine engineering work vessels, which puts forward some problems in the experiment and lays the foundation for follow-up research.

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