ID29- UNDERWATER LIGHT ESTIMATION USING THE OBSEA CAMERA

MARC NOGUERAS, JOAQUIN DEL RÍO

SARTI Research Group, Electronics Department, Universitat Politècnica de Catalunya; UPC, 08800 Vilanova i la Geltrú-Barcelona, Spain, marc.nogueras@upc.edu

Abstract
This is a description of the method used in the OBSEA observatory to obtain a value for the amount of light present in the seafloor using the existing video surveillance camera.

Keywords
Cabled seafloor observatories, light measurement, underwater camera.

INTRODUCTION
OBSEA is an underwater seafloor observatory located in a shallow water environment at 20m depth and 4km offshore Vilanova i la Geltrú coast. OBSEA is equipped with many oceanographic instruments one of them is a PTZ camera [1]. The camera is a Sony SNC-RZ25N model for video surveillance mounted inside a hemispherical glass dome model OPT-06 developed by "Ocean Presence Technologies". With this camera is possible to take pictures of the environment of the observatory [2]. Due to the observatory is not equipped with any light detector, it has been considered to use the video surveillance camera to estimate the amount of light present at the seabed. Due to the camera is not providing any value for the light measurement an algorithm has been developed to make a first estimation from the normal parameters that can be obtained with a camera. All the algorithm for the calculations and control of the camera has been developed with a LabVIEW graphical programming.

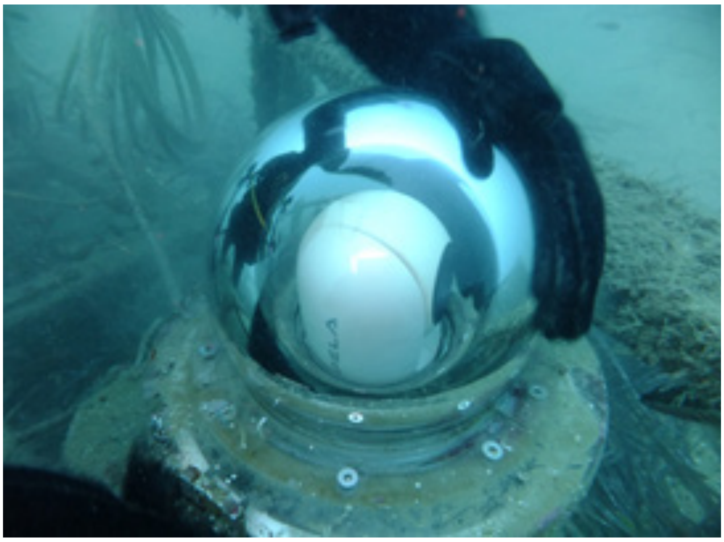

Fig 1. Underwater camera OPT-06

MATERIAL AND METHOD
To be able to obtain an estimation of light quantity proportional to the real light present in the seafloor, it has been used the mean value of luminance of the captured jpeg image and three configuration parameters of the camera: the shutter speed, iris and gain. In addition, to avoid influence of the white balance in the measurement, it has been configured a fixed white balance with the parameters of R and B gain more adequate for the most part of light conditions. The first step of the algorithm is to calculate de exposure value (EV), that is a logarithm function of exposure time (T) and F number or iris aperture (N):

$$EV = \log^2(N2/T)$$

At the same time is obtained the illuminance value (Y) of the taken picture. The illuminance is the mean value of the pixels (R, G and B) of the picture compensated by a weight for the colour of the pixel. In order to improve the feasibility of the measurement, every measurement has been done taking 3 pictures with different values of EV. At the same time to have a quality indicator of the measure it is registered if the picture was correctly exposed or if it was over or under exposed.

$$Y = (R*0.2126 + G*0.7152 + B*0.0722) / 256$$

The method to evaluate the quality of the exposition is observing the histogram of the picture. Only histograms with all the pixel values different from 0 and 255 are accepted. This method avoids that dark or overexposed images can be used to compute the light of the scene.

Then the value for the light (L) is a function of the Exposure Value (EV), Illuminance (Y) and Gain (G).

$$L = Y * (A^{EV}) / G \quad \text{where} \quad A=1.707$$

Where A is an empirical value obtained from the measurements that minimizes the variability of the measurements in function of the exposure value.

Due to all this method has been developed without the possibility to calibrate the measurements in a known environment, the obtained value of light does not have physical units and it is usable only as a relative measurement of the light variability along the time. In any case, when it will be possible to recover the underwater camera from the seabed and bring it to the laboratory a calibration process will be done to convert the light measurement to Lux.

After measuring the light periodically for 4 months is possible to see the light variability in the observatory in the following pictures. In the Fig.2 is shown a 9 days sample of the calculated data, the unfiltered data has all the measures from the camera, the filtered one has the only the measures coming from images correctly exposed. Due to most of the images taken during the night are underexposed filtered data only has information of the day.

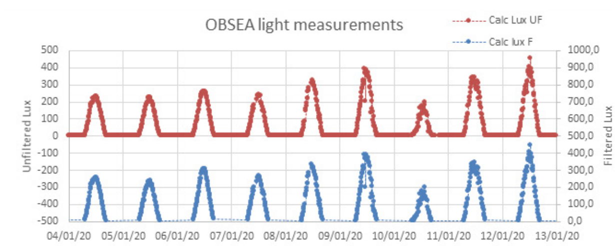

Fig 2. Seafloor light measurement

Fig.3 shows data organized in hours and days. The first day of the test was 13/11/2019 and the last (#118) was 11/03/2020. This figure has been done averaging data in periods of 15 minutes and is possible to see how is increasing the daylight time along the year. It is possible to see also that in some periods there is very few light during the day, these periods of darkness are done to big storms that move so much sediment that they do not let any light reach the sea floor. From these data been has extracted the schedule of daylight in the seafloor and compared to the official sun schedule. In fig.4 can be seen that light is present in the observatory around 20 minutes before the sunrise and 30 minutes after the sunset. In the fig. 5 can be seen the histogram of the dataset where the highest values are concentrated between 10:00 and 14:00 and the lowest values between 16:00 and 8:00.

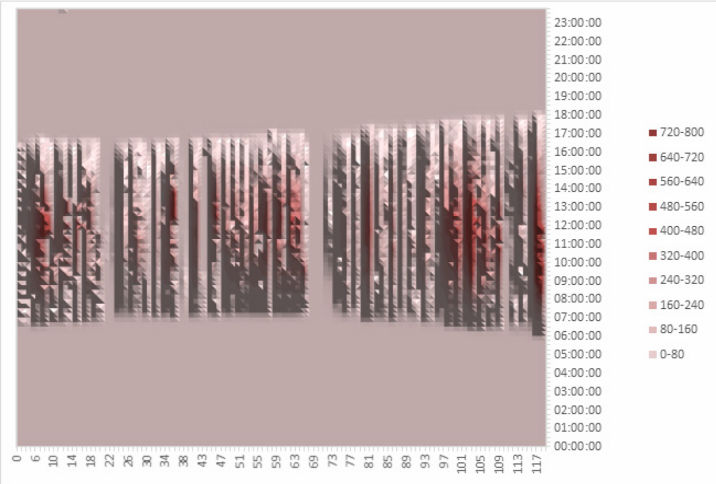

Fig 3. Mean light measurement per hour and day

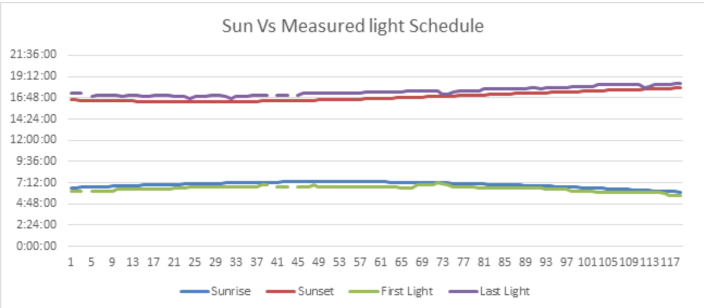

Fig 4. Sunrise and Sunset versus measured light schedule

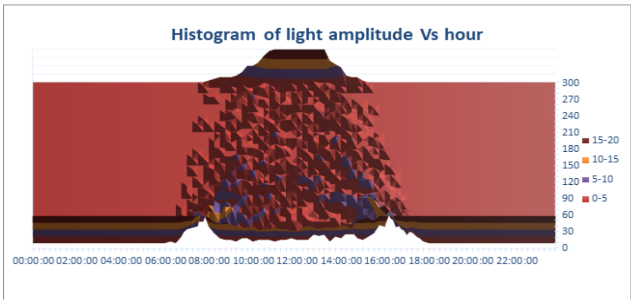

Fig 5. Light histogram

CONCLUSIONS

In conclusion, this method of underwater light measurement can be useful for the correlation of other measurements that are being done in the observatory using the camera such as the marine species monitoring.

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