M6 # OPTIMAL PATTERN DESIGN FOR AUTOMATIC ESTIMATION OF WATER TRANSPARENCY THROUGH PHOTOGRAPH USING CROWDSOURCING DATA

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Abstract

Based on crowdsourcing data, the study aims at developing a simple method to automatically compute the water transparency. With underwater camera pictures, an image processing technique should provide robust estimations of parameters related to water transparency. We will mainly see the first step: estimating the distance from the image to the camera and the optimal choice of a pattern to photograph.

Keyword: Image processing, Distance estimation, Crowdsourcing, Underwater imaging

INTRODUCTION

Water quality (WQ) of the sea is of great interest for many applications such as fishing, leisure, detection of harmful algal bloom. Recently, various studies have used low-cost commercial digital cameras to study WQ [1]. The set-up of these projects are cumbersome however (see fig. 1 for example)

The study presented here is part of the Citclops FP7 European project (www.citclops.eu) which aims at using crowdsourcing optical data to assess WQ in the sea. Indeed, involving citizens to collect data leads to unprecedented level of coverage. Therefore easy-to-use and easy-to-carry device should be used, coupled with robust image processing techniques for a large amount of data.

Here, we analyse one of the Citclops goals: the development of a robust method to estimate transparency related parameters based only on image processing of pictures obtained with underwater digital cameras. To achieve it, a series of pictures will be taken at different distances. A first step is thus to estimate the distance at which they are taken, This work is centred on this step.

METHODOLOGY

Following the method proposed in [1], the attenuation K for each colour band (RGB) can be estimated as:

$$K(\lambda) = -\frac{1}{z_1 - z_2} \ln \frac{L(\lambda, z_1)}{L(\lambda, z_2)} \qquad (1)$$

where Z_1 and Z_2 are two different distances and L is the measured brightness (radiance) for each particular band. In [1] the distances Z_1 and Z_2 were fixed in the pole structure (Fig 1). In our application, the pattern will be held by a diver while another one will take 2 or 3 pictures of a pattern at different distances. Our main contribution here is to automatically evaluate the distances from the pictures.

The basic idea is to binarise the image through thresholding and then to compute the black area size (BAS). From the BAS, we showed that the distance can be estimated, see [2].

OPTIMAL DESIGN OF THE PATTERN

In [2], we used a rectangular pattern but we will now show that a circle is optimal. Indeed, the problem is that the picture is likely to suffer an angle deviation. In Fig. 2, we demonstrate that even with an important distortion where the circle is converted into an irregular ellipsoid, the maximum distance between points of the ellipsoid stays equal to the diameter of the original circle.

Fig. 2. Optimal design of the pattern. The original figure has been rotated along the three axes and then projected so

that RHS figure is the one seen by the camera after the rotation.

In Fig. 2, the contours are computed and the maximum distance between the points of the contour deduced. It can be seen that its value is very close to the diameter.

CONCLUSIONS

The results obtained indicate that it is possible to obtain distances estimations with automatic image processing techniques. The circle is a very simple and robust pattern to be used for distance estimation. Further research has to be done to analyse the robustness of the estimation to different uncontrolled parameters (noise, turbidity, …). More complex processing may be required (for example using wavelets) but robustness and simplicity are priorities in our design, in a crowdsourcing framework, as we will have to deal with little precise pictures but large data sets.

REFERENCES

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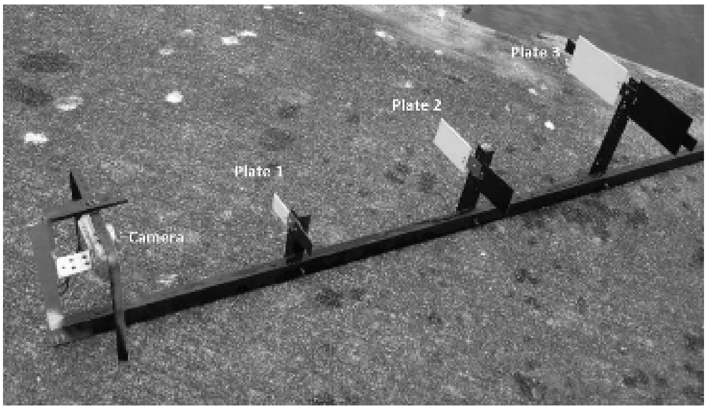
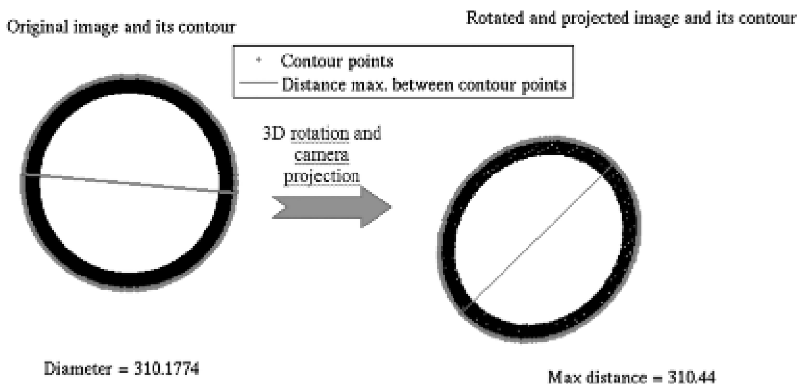


Fig. 1: Secchi 3000 Device. The pole weights 1.7kg + the camera, total length is 1.56m.



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