DEVELOPMENT OF A COMPUTER APPLICATION TO CALCULATE CYCLISTS FRONT AREA IN STUDIES ABOUT AERODYNAMICS

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INTRODUCTION

Aerodynamic studies are usually accomplished in the wind tunnels. In the cycling, variables as aerodynamics drag coefficient, surface of the object, front area, were found in the literature [2,3,4,5] and are necessary for the calculations about aerodynamic of the cyclist and/or equipments. Limitations related to this calculation are found. For example, the front area has been considered as constant, and relative at 18% of the total corporal surface obtained by prediction equations [1]. The aim of this study was to propose a method to calculate the cyclist front area through tools of images processing, with the development of a computer application, searching to provide results that can be used in the analysis of aerodynamics in cycling.

METHODS

The first step in the development of the computer application is to determine how to obtain the necessary information. For the development of the computer application the IDL 6.0 (Research Systems Inc.) was used, allowing the work with different forms of data, through computational mathematics. One of the causes of the choice of the IDL was his characteristic multi-platform, facilitating its use in many operating systems. To compile the computer application is only necessary the installation of an IDL Virtual Machine (Virtual IDL Machine – freeware - www.rsinc.com), don't depending of the installation or acquisition of software. Inside of the possibilities of images processing, the second step went verify which would bring a better result. Thus, the computer application was developed based in the image segmentation, with the Roberts operators, the oldest and simple algorithm of detection of borders, using a matrix 2x2 to find the changes in the directions x and y through the Roberts mask (Figure 1).

$$\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} \quad \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$

G_x G_y

Figure 1: Roberts mask

With the mask, if the calculated magnitude is larger than the smallest entrance value (defined in agreement with the nature and quality of the image processed), the pixel is considered, or not, be part of a border. The small size of the mask for the operator of Roberts is easy to implement, and also fast to calculate. The analyses are very sensitive to the image noise. After image segmentation, a method for the calculation of the area is necessary, because the image didn't possess defined dimensions. The third step involved the use of an object of well-known dimensions, photographed with the cyclist, and that supplied parameters for the space calibration in meters.

RESULTS AND DISCUSSION

The tests were accomplished with digital pictures obtained with photographic camera Nikon Coolpix 885 and the computer application presents the necessary characteristics to the front area analysis, with easy use. Using the commands options in the graphic interface of the computer application, the user follows the necessary steps for the analysis. After, the results with image information could be record in a text file for posterior analysis.

CONCLUSIONS

In summary, the computer application has success in the front area calculation and showed an applicable methodology to the cycling, many influenced and dependent of the aerodynamics, as the cyclist body position and equipments or accessories.

REFERENCES

1 - Du Bois, D. & Du Bois, E. F. Clinical calorimeter : a formula to estimate the approximate surface area if height and weight be known. *Archives of Internal Medicine*. 17, p:863-871. 1916.

2 - Di Prampero, P. E., Cortilli, G., Mognoni, P., Saibene, F. Equation a motion of a cyclist. *Journal of Applied Physiology*, 47 (1), p:201-206, 1979.

3 - García-Lopez, J., Peleteiro, J., Rodríguez, J. A., Córdova, A., González, M. A., Villa, J.G. Biomechanical assessment of aerodynamic resistence in proffessional cyclists: methodological aspects. *Proceedings of International Symposium on Biomechanics in Sports*. p: 286-289, 2002.

4 - Padilla, S., Mujika, I., Angulo, F., Goiriena, J. J. Scientific approach to the 1-h cycling World record: a case study. *Journal of Applied Physiology*. 89, p:1522-1527. 2000.

5 - Tew, G. S., Sayers, A. T. Aerodynamics of yawed racing cycle whells. *Journal of Wind Engineering*. 82, p: 209-222. 1999