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Kai Lin, Chao Zhou, Daming Xu, Qiang Guo, Xinting Yang, Chuanheng Sun

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Kai Lin [a,b,c], Chao Zhou [a,b,c], Daming Xu [a,b,c], Qiang Guo [a,b,c], Xinting Yang [a,b,c,*], Chuanheng Sun [a,b,c,*]

[a] Beijing Research Center for Information Technology in Agriculture, Beijing100097, China

[b] National Engineering Research Center for Information Technology in Agriculture, Beijing100097, China

[c] National Engineering Laboratory for Agri-product Quality Traceability, Beijing100097, China

*Corresponding author: sunch@nercita.org.cn

Abstract

Monitoring of fish behavior has drawn extensive attention in pharmacological research, water environmental assessment, bio-inspired robot design and aquaculture. Given that an infrared sensor is low cost, no illumination limitation and electromagnetic interference, interest in its use in behavior monitoring has grown considerably, especially in 3D trajectory monitoring to quantify fish behavior on the basis of near infrared absorption of water. However, precise position of vertical dimension(z) remains a challenge, which greatly impacts on infrared tracking system accuracy. Hence, an intensity (L) and coordinate (z) correlation model was proposed to overcome the limitation. In the modelling process, two cameras (top view and side view) were employed synchronously to identify the 3D coordinate of each fish (x-y and z, respectively), and the major challenges were the distortion caused by the perspective effect and the refraction at water boundaries. Therefore, a coordinate correction formulation was designed firstly for the calibration. Then the L–z correlation model was established based on Lambert's absorption law and statistical data analysis, and the model was estimated through monitoring 3D trajectories of four fishes during the day and night. Finally, variations of individuals and limits of the depth detection of the model were discussed. Compared with previous studies, the favorable prediction performance of the model is achieved for 3D trajectory monitoring, which could provide some inspirations for fish behavior monitoring, especially for nocturnal behavior study.

Key words: infrared imaging; correlation model;3D trajectory

1. Introduction

Fishes are sensitive to environmental changes, and these changes can induce distinctive movement and behavioral variation [1]. Therefore, monitoring of fish behavior is of great value for behavior studies, pharmacological research [2], water environmental risk assessment [3], bio-inspired robot design [4] and