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ID35 EXPERIMENTS ON ZEBRAFISH USING MINI ROBOT FISH PROTOTYPES TO IDENTIFY STRESSORS

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ABSTRACT

This paper describes the behavioural tests carried out with real fish to study their behaviour and stress against the different prototypes of mini-robot fish with the aim of identifying stressors and reducing them when designing future robots for aquaculture.

Keywords - Aquaculture, fish behaviour, robot-fish, stress factors, robot biomimicry

INTRODUCTION

Certain research papers provide detailed reviews of the main characteristics of fish [1][2], on how changes in morphological structure, patterning, coloration or movement of fish affect how they relate to other fish of the same species [3], and also on the behavior of fish schools when interacting with robotic fish-like systems [4][5][6]. Based on this information, different prototypes of small free-swimming robotic fish are developed in this project, with relative similarity to zebrafish (Danio Rerio), with the objective of determining and reducing the stressors introduced by a robot in aquaculture applications.

Three robotic fish prototypes have been developed: two based on the redesign of a commercial robotic fish driven by electromagnetic actuators, focused on imitate the zebra fish shape, and one prototype based on an original design driven by a servo motor and controlled remotely via Bluetooth, focused on testing different tail beat frequencies.

EXPERIMENTAL SETUP

For the behavioural tests, planning has been carried out, developing a matrix of factors that allows all aspects to be tested on different versions of the prototype, by the colours used, the pattern of the lines on the back, the shape of the body, the size or the beat of the tail, among other possible stress factors.

For these analyses, different tests have been performed, using different sized tanks since the space available to the fish to face the threat may influence their response. Firstly, first contact tests (Fig.1) have been carried out, analysed in a preliminary way by ocular inspection and time measurement, until the fish no longer feels threatened. This helps us to get information that can be useful in planning and guiding the subsequent detailed experiments. These first contact tests were carried out with isolated individuals, to study their response to the robot individually, and then with more than one individual to study the change in behaviour when the situation is faced as a group.

Secondly, behavioural tests were performed with isolated individuals in narrow tanks for 2d image processing analysis. The image software allows statistically to determine the significance of the studied variables and their potential stressor degree.

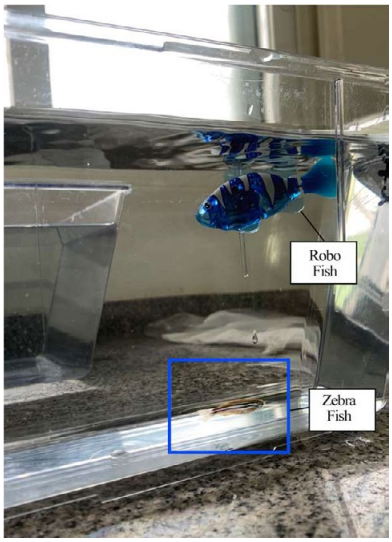

Fig 1. Preliminary test with robotic fish

CONCLUSIONS

Through the different prototypes of mini-robot fish and thanks to the different stress tests carried out with real fish, it has been possible to determine the factors present in the robots that can cause greater stress in the fish, in order to modify or avoid them in future prototypes and obtain less stressful robotic fish.

For these behavioural tests with zebrafish, the stress response of the fish when faced with a robot that could be interpreted as a stranger or a threat was studied. As a part of the future work of this research line these results can be applied in the design of a more robust and technologically capable prototype that can be tested in tanks with larger fish or directly as a part of an inspection system in fish farms.

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