Development of Automatic Software for Dissecting Complex Social Behavior in Fish and Crayfish

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Abstract

Understanding complex social interactions in aquatic organisms is pivotal for effective conservation, aquaculture, and ecological research. Traditionally, ethological studies have relied on extensive manual observation and coding of animal behavior, a process that is time-consuming, subjective, and prone to human error. This research presents the development of innovative, automated software designed to dissect and quantify intricate social behaviors in fish and crayfish species. The software incorporates advanced computer vision and machine learning algorithms to accurately detect, track, and classify a wide range of social behaviors, including fighting, chasing and prey-predator interaction. By employing deep learning techniques, the system is capable of recognizing individual animals, even within densely populated environments, and extracting detailed information about their spatial relationships, body postures, and movement patterns. The developed software offers several key advantages over traditional methods. Firstly, it significantly reduces the time and effort required for behavioral analysis, allowing researchers to focus on higher-level interpretations and hypothesis testing. Secondly, it provides objective and quantitative data, minimizing the impact of human bias and increasing the reliability of research findings. Thirdly, the software enables the collection of large-scale datasets, facilitating the identification of subtle behavioral patterns and the discovery of novel social phenomena. Potential applications of the software span various fields of aquatic biology. In conservation, it can be used to assess the impact of environmental stressors on social behavior, inform habitat restoration efforts, and monitor the effectiveness of conservation interventions. In aquaculture, the software can optimize breeding strategies, improve animal welfare, and enhance production efficiency. Furthermore, it can contribute to fundamental research on social evolution, communication, and ecotoxicity to aquatic animals.

Keywords: Fish; Crayfish; Automated analysis; Computer vision; Machine learning; Ethology; Aquaculture; Toxicology

Related publication:

Luong et al. 2024. Fish 3D locomotion APP (F3LA): a user-friendly computer application package for automatic data calculation and endpoint extraction for novel tank behavior in fish. Journal of Fish Biology (In press)

Suryanto et al. 2023. Using crayfish behavior assay as a simple and sensitive model to evaluate potential adverse effects of water pollution: emphasis on antidepressants. Ecotoxicology and Environmental Safety 265, 115507.

Saputra et al. 2023. Using DeepLabCut for markerless cardiac physiology and toxicity estimation in water fleas (Daphnia magna). Aquatic Toxicology 263, 106676.