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AcousNomaly: Generating Aquatic Acoustic Telemetry Data from Real Data while Learning to Detect Anomalies with Unsupervised Learning

This research project aims to investigate the movement behavioural patterns of dusky kob (Argyrosomus japonicus) from the Breede Estuary using acoustic telemetry data. A group of 50 dusky kob were surgically fitted with unique coded acoustic transmitters, and their movements were monitored using an array of 16 acoustic receivers deployed throughout the estuary between 2016 and 2021, resulting in more than 3 million individual data points. Acoustic telemetry data plays a vital role in understanding the behaviour and movement of aquatic animals. However, these datasets often contain anomalous detections that can pose challenges in data analysis and interpretation. Anomalies in acoustic telemetry data can occur due to various factors such as biological factors, environmental factors, and technological limitations. Given that ichthyologists currently rely on manual detection to identify fish with anomalous behaviour or movement, this study focuses on automating the process of anomaly detection in telemetry datasets using machine learning (ML) and artificial intelligence (AI) models. The objective is to address the time-consuming nature of manual anomaly detection, especially in large datasets such as the one considered in this research, which consists of over 3 million instances. The proposed approach combines the use of LSTM (Long Short-Term Memory) models and autoencoders to construct an efficient anomaly detection system.

The model has undergone fine-tuning and preliminary work indicates that it is proficient at learning the normal patterns within the data, effectively distinguishing between normal and anomalous behavior. However, it may encounter challenges in accurately detecting anomalies, particularly in cases where they deviate slowly from the expected patterns. Despite this limitation, the model demonstrates promising capabilities by pinpointing the precise locations of anomalous entries within the dataset. Further investigation, including refinement and optimization of the model's parameters and training process, especially with memory-based LSTM-AE may enhance its ability to detect anomalies with greater accuracy and reliability. Our proposed LSTM-AE model showed a 98% score in all four evaluation metrics including accuracy, precision, recall, and F1, based on the preliminary test results.

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