ESTIMATING THE SWIMMING SPEED OF SALMON IN AQUACULTURE SEA CAGES USING COMPUTER VISION

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In a commercial aquaculture farm, knowledge about fish behaviour can influence farm management, fish growth and operating costs. In this presentation we describe research towards the development of the first stage of a system that will track fish movement in a sea cage and automatically analyse fish behaviour based on the movement. This first stage involves the design and implementation of a tracking system that will calculate the average speed and direction of fish in a sea cage. The system uses an underwater camera which captures video to a digital recording device. Captured video is then analysed, using computer vision software, to produce an average speed for every sampling period. The software can track up to 8 fish at a time and uses the Kalman Filter technique for estimation of fish position and the Global Nearest Neighbour algorithm for measurement-to-track association.

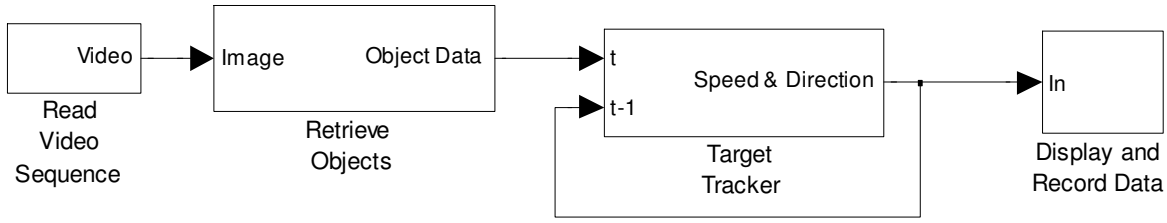
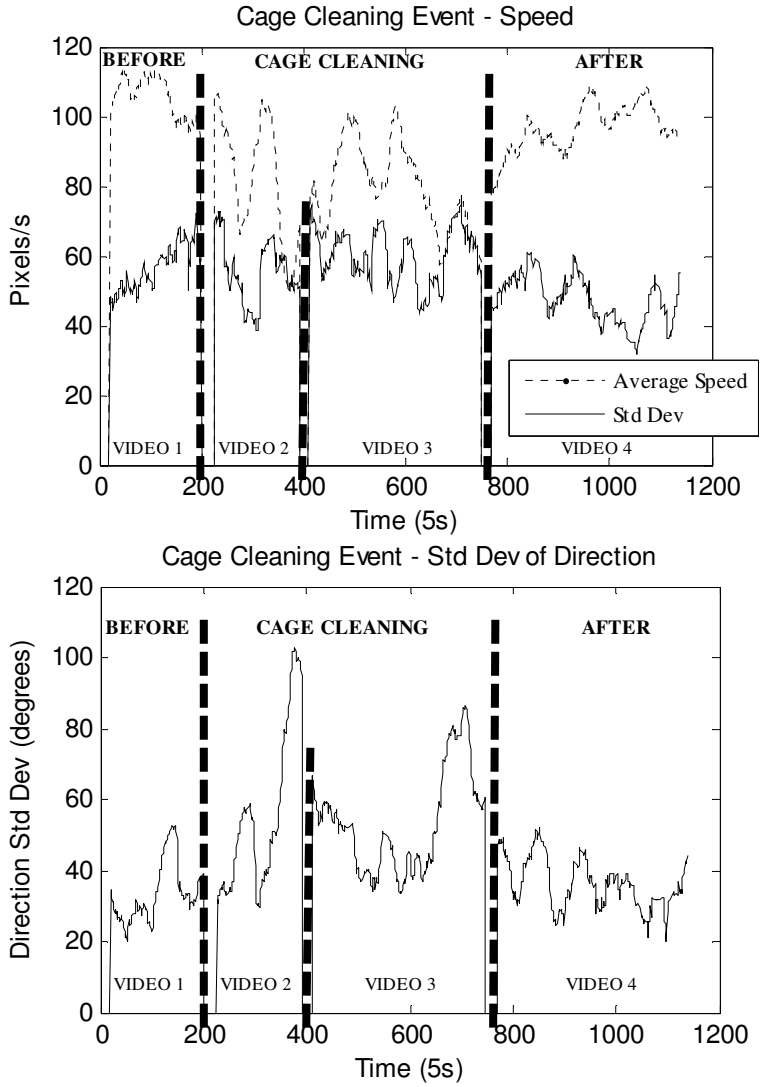


Figure 1: Tracking system based on Kalman Filter

The initial investigation focused on a cage cleaning event. The results show that an average speed can be estimated, but careful consideration needs to be given to the movement of the camera which increases the noise inherent in data. In addition results showed that the variance of fish direction is higher during the cage cleaning compared with that before or after the cleaning event. The daily routine of fish was also investigated. The main emphasis was placed on swimming speed before, during and after feeding but the overall analysis of swimming speed allowed us to establish a baseline behaviour which can be compared, in future, with behaviour which occurs during specific events, such as cage cleaning or predator threat.

This study shows that innovative use of technology can be of benefit to aquaculture farms. Further studies will aim to improve the tracking system and develop a behaviour analysis system, so that eventual real-time deployment on a commercial aquaculture farm is possible. Immediate knowledge of fish behaviour and welfare by operators can lead to improved management techniques, decreased operating costs and better product quality.



	Speed pixels/s	Speed Std Dev	Direction Std Dev
Before	105.46	56.47	33.56
Cleaning 1	81.85	55.36	55.73
Cleaning 2	79.73	60.16	53.1
After	96.67	47.4	36.21

Figure 2: Averages of sampling points during 4 video sequences