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Editorial

Editorial for Special Issue: Fishery Acoustics, Applied Sciences, and Practical Applications

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1. Introduction

Fishery acoustics (How to detect and monitor fish and other marine life?) and bioacoustics (How does marine life use sound?) are closely connected domains [1]. The fishery acoustics discipline covers a wide range of research and practical application topics using acoustical devices as sensors in aquatic and ocean environments [2]. Underwater acoustic techniques can be applied to sensing aquatic animals, zooplankton, fish, and physical and biological habitat characteristics for biomass estimation and stock assessment [3]. As a means for fishery acoustics, information and communication technologies (ICT) have brought various useful tools and services, enabling another ICT-based industrial revolution for the last few decades. Subsequently, underwater acoustics and their aquaculture applications have been widely investigated, including information processing and intelligent signal processing techniques over the harsh and boundary underwater acoustic channel [4].

Fishery acoustics compose a well-defined scientific area physically and theoretically for information of underwater biomass, while information processing and intelligent signal processing engineering complements practical devices as systems for interdisciplinary underwater acoustics. Various tools are emerging from both the underwater acoustic sciences and fishery engineering, and we can fully utilize them. Subsequently, we are expecting a quantum leap in areas of interdisciplinary fishery acoustics, covering stock assessment, aquaculture monitoring system, underwater object monitoring, underwater fishery surveillance, and many more applications for fishery businesses. Further, there are expected abundant technical touches on various scientific and engineering topics on principles and applications of fishery acoustics, including, but not limited to, the following:

- Fish finding and stock assessment using underwater acoustics;
- Robust fishery detection/estimation for fish stock assessment;
- Intelligent signal processing systems for fishery acoustics;
- Information processing and intelligent signal processing techniques for fishery;
- Underwater fish tracking and surveillance systems;
- Devices and systems for fishery stock assessment;
- Computational ocean dynamics, moving particle modelling, and fishery simulation.

To comply with the requests in the fishery science, applications, and emerging issues, a total of two dozen submissions were submitted, and 10 papers were selected for publication in this issue. These selections shall serve as a recent forum for presenting innovative and new developments quite relevant for the scope of this special issue as specified in the following keywords: (1) Acoustic Biomass Estimation, (2) Fishery Detection and Tracking, and (3) Fishery Tools.

2. Acoustic Biomass Estimation

The first interest in the fishery science and applications is what amount of biomass we can estimate in a limited space of ocean under a realistic situation. The practical approach is quite straightforward, (1) each target fish is quantified as Target Strength amount, (2) which can be described as a reflected amount of acoustic backscattering from the target, (3) using an underwater acoustic transceiver, and (4) the total integrated backscattering represents the amount of the biomass or the number of biomass once normalized by the Target Strength. The practical approach still has many pitfalls to be filled. There are many fish species in the real world, and we need constant evaluation of Target Strength specific to each fish at each environment. Backscattering is a hypothetical concept, for which real measurements need analytic investigation on multiple scattering theory especially for the dense biomass. Practical instruments are still evolving for measuring physical acoustic strength. Finally, counting is another difficulty, while the distribution of fish length is another issue to be resolved concurrently.

In the paper "Acoustic Target Strength of the Endangered Chinese Sturgeon (Acipenser sinensis) by Ex Situ Measurements and Theoretical Calculations", Zhang et al. [5] presented the Target Strength of Chinese Sturgeon with 250 cm for the first time, using a 199-kHz split echo sounder. The sturgeon breeding in the Yangtze River is critically important for effective management and population preservation, and this research is expected to provide a good basis for future hydroacoustic studies on the critically endangered Chinese sturgeon.

Another Target Strength measurement on Redlip mullet (Chelon haematocheilus) distributed in coastal waters of the North-Western Pacific Ocean is reported in [6], which is popularly aquacultured in Korea. In [6], Kim et al. used the split-beam scientific echo sounder comprised of 38, 120, 200, and 420 kHz frequencies.

Linløkken et al. [7] explored and reported acceptable differences of fish density and Target Strength distribution estimates between two ingle beam systems, EK15 and EY-M, in the paper "Comparing Fish Density and Echo Strength Distribution Recorded by Two Generations of Single Beam Echo Sounders". They showed that the measurement site, the oligotrophic Lake Storsjøen (48 km^2), has nurtured the introduced smelt population since 2013, by using the dramatic increase of density of TS = −46 to −44 dB echoes (>10 cm) between 2013 and 2016.

In the paper "Variation of Zooplankton Mean Volume Backscattering Strength from Moored (750 KHz) and Mobile (307.2 KHz) ADCP Instruments for Diel Vertical Migration Observation", Dwinovantyo et al. [8] used acoustic Doppler current profiler (ADCP) instruments to measure the mean volume backscattering strength (MVBS), with proper deletion of the Zooplankton migration effect. The results include analysis of the MVBS and vertical velocity from ADCPs at the same time and location for zooplankton's daily vertical migration (DVM) observation.

3. Fishery Detection and Tracking

Fishery scientists and fishermen are sometimes curious about the location of fish and moving behaviors, in conjunction with the environment changes or manmade effects, to manage the biomass properly. These problems can be identified as locating, tracking, and monitoring.

In the paper "Hydroacoustic and Pressure Turbulence Analysis for the Assessment of Fish Presence and Behavior Upstream of a Vertical Trash Rack at a Run-of-River Hydropower Plant", Schmidt et al. [9] investigated the spatial distribution of fish upstream of a vertical trash rack at a hydropower plant to monitor fish presence and flow characteristics at large hydro power sites. They used combining hydroacoustic observations of acoustic cameras (DIDSON and ARIS) and acoustic Doppler current profiler (ADCP), for fish locations with multivariate hydrodynamic data. This work suggests a multimodal monitoring approach, incorporating both fish position data and hydrodynamic information to create an automated fishery detection and monitoring system to assist fish protection operations in near real time.

In [10], Eiler et al. suggested an approach using an autonomous underwater vehicle (AUV) to map the fish movement, in the paper "Tracking the Movements of Juvenile Chinook Salmon using an Autonomous Underwater Vehicle under Payload Control'. The AUV, after detecting a tag, deviated repeatedly from its preprogrammed route and performed a maneuver designed to enhance the location estimate of the fish and to move closer to collect proximal environmental data. The results suggest that AUV-based payload control can provide an effective method for mapping the movements of marine fish.

4. Fishery Tools

The last topic, not least, to implement practical implementations, is about supporting tools for the fishery, such as fishery gears design and analysis, assessment of ocean effects on the fishery, and other indirect factors for appropriate consideration of the fishery supports and environment.

In [11], Jin et al. investigated the behaviors of a Bottom-Set Gillnet, for various current and wave conditions and failure scenarios through simulations. The paper "Monitoring-System Development for a Bottom-Set Gillnet through Time-Domain Dynamic Simulations", by Jin et al., presumes the southwest seashores of the Korean peninsula and investigates the sensor-based monitoring feasibility of a bottom-set gillnet through time-domain dynamic simulations with efficient numerical modeling of nets—An equivalent net model. The proposed monitoring system consisted of an accelerometer, tension sensors, and the global positioning system. Numerous line-failure scenarios were simulated, and it is verified that the proposed monitoring system could effectively detect a specific problem from the combined patterns of sensor signals by a problem-detection algorithm.

Further, in [12], titled "Response Prediction and Monitoring Feasibility of a Stow Net System Using Measured Environmental Data in the Southwest Coast of Korea", Jin et al. investigated the response characteristics of a stow net under various coastal environments. The feasibility of its monitoring system to check net functionality and prevent loss of fishing gears were simulated with the measured wave and current data, acquired in the southwest coast of South Korea.

The coastal environments are important in the analysis and simulations of the fishery or ocean related systems, and proper estimation of ocean parameters are necessary to be resolved first.

Kim et al. proposed one example of how to estimate the ocean wave spectrum in [13], "Real-Time Inverse Estimation of Ocean Wave Spectra from Vessel-Motion Sensors Using Adaptive Kalman Filter", in real time.

The last contribution is not directly related to the fishery but to be useful for computational vibration and dynamics while implementing fishery machinery. Chu et al. presented an experimental study of the positive effects of vibration-assisted deep drilling of aluminum alloy [14], using both methods of conventional drilling (CD) and ultrasonic-assisted drilling (UAD). The result shows that the UAD provides more positive effects in the sense of the material removal rate, the average workpiece temperature and torque, and the tool life.

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