Autonomous Monitoring Systems for Aquaculture and Offshore Installations

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BACKGROUND

Global demand for macroalage aquaculture is expected to grow significantly in the coming decade, as a sustainable food resource, a potential tool for marine carbon dioxide removal, a biofuel source, and a source of ingredients used in pharmaceuticals and cosmetics. Traditional commercial macroalgae monitoring is time, labor, and cost intensive, with manual inspection limited to surveying small areas and to shallow depths. Remote sensing using satellites has been used to monitor aquaculture installations, but it is not useful in the early growth stages or in subsurface observations. New quantitative tools for autonomous monitoring and maintenance are needed to ensure the growth and successful maturation of the macroalage industry. Advanced acoustic technologies such as side scan sonar (SSS) have long been established as a tool within the fishing industry, but sonar use in commercial macroalgae aquaculture has not been used extensively. Sonar allows for large-scale measurement of crop growth and remote assessment of infrastructure integrity and has the potential to be a significant component in autonomous monitoring of offshore aquaculture installations.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a novel side scan sonar system that enables three-dimensional tomographic analysis for autonomous monitoring of offshore aquaculture and infrastructure. This technology uses side scan sonar units towed in opposing directions to capture two-dimensional images of underwater targets within a defined area or farmed plot. The two images collected in different directions are aligned by an algorithm to create a three-dimensional point cloud that accurately maps objects' locations beneath the sea surface. The resulting 3D map provides a detailed assessment of macroalgae crops and infrastructure integrity. By monitoring changes in the map over time, it enables farmers to track crop growth, biomass estimates, and the soundness of the underwater infrastructure. The in-situ biomass estimates can be used to increase efficiency and improve decision making on large-scale aquaculture installations, decreasing cost and labor. This method may also have utility in other offshore installations including floating wind farms and hydrocarbon extraction.

ADVANTAGES

- Enables autonomous monitoring of underwater aquaculture and infrastructure
- Allows for large-scale measurement of biomass and structural integrity
- Reduces operational costs and labor

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OTHER INFORMATION

KEYWORDS

aquaculture, sonar, side-scan sonar, hydrocarbon, wind farm, tomographic, macroalgae, biomass

CATEGORIZED AS

- **Imaging**
  - Remote Sensing
- **Sensors & Instrumentation**
  - Environmental Sensors

RELATED CASES

2025-339-0

- Permits observation of initial growth stages and subsurface conditions
- Operates effectively regardless of weather conditions

APPLICATIONS

- Aquaculture
- Hydrocarbon extraction
- Floating wind farms
- Coastal infrastructure assessment

PATENT STATUS

Patent Pending

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