

# Structured Abstract of the Doctoral Thesis

## Title:

*Open-Source Based Prototyping Methods for the Development of Smart Tailor-Made Marine Monitoring Systems*

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## Objective:

This thesis addresses both technical and economic challenges in the field of marine environmental monitoring, with a particular focus on turbidity measurement. The primary objective is the development of a modular, open-source platform that enables non-expert users to design and operate cost-effective, application-specific monitoring systems.

## Research Approach and Methodology:

The work employs an iterative rapid prototyping methodology to design and evaluate an open sensor platform. Key components include:

- Development of a modular hardware and software architecture
- Use of open standards and freely available components
- Integration of sensor technologies into pressure-tolerant and robust casings
- Application of additive manufacturing for rapid adaptation to diverse requirements
- Validation of the systems in various real-world marine scenarios

## Application Cases:

1. **Aquaculture Monitoring:** Development of a prototype for qualitative detection of turbidity variations in closed aquaculture systems.
2. **Coastal Monitoring:** Advancement to a field-ready version for deployment in natural environments, including improved hardware integration.
3. **Fishery Impact Assessment:** Creation of a sensor capable of quantitatively measuring sediment plumes generated by bottom trawling.
4. **Deep-Sea Mining:** Deployment of a pressure-resistant prototype for monitoring low-level turbidity under extreme deep-sea conditions.

## Key Findings:

- The developed platform enables reliable turbidity measurements at a fraction of the cost of commercial systems.
- Open interfaces and modular design ensure high adaptability to a wide range of applications.
- A novel calibration method based on milk-water mixtures offers a safe, accessible alternative for non-specialist users.
- The system architecture proved to be robust, maintainable, and suitable for operation in challenging marine environments.