Precision microplastic sensor: AI and optics for environmental monitoring

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Introduction

Microplastic pollution threatens aquatic ecosystems and human health globally [1]. Microplastics absorb toxins and are ingested by marine life, entering the food chain and posing risks to wildlife and humans [2]. Addressing this requires advanced detection and innovative solutions, like the microplastic sensor introduced in this study.

Microplastic Sensor

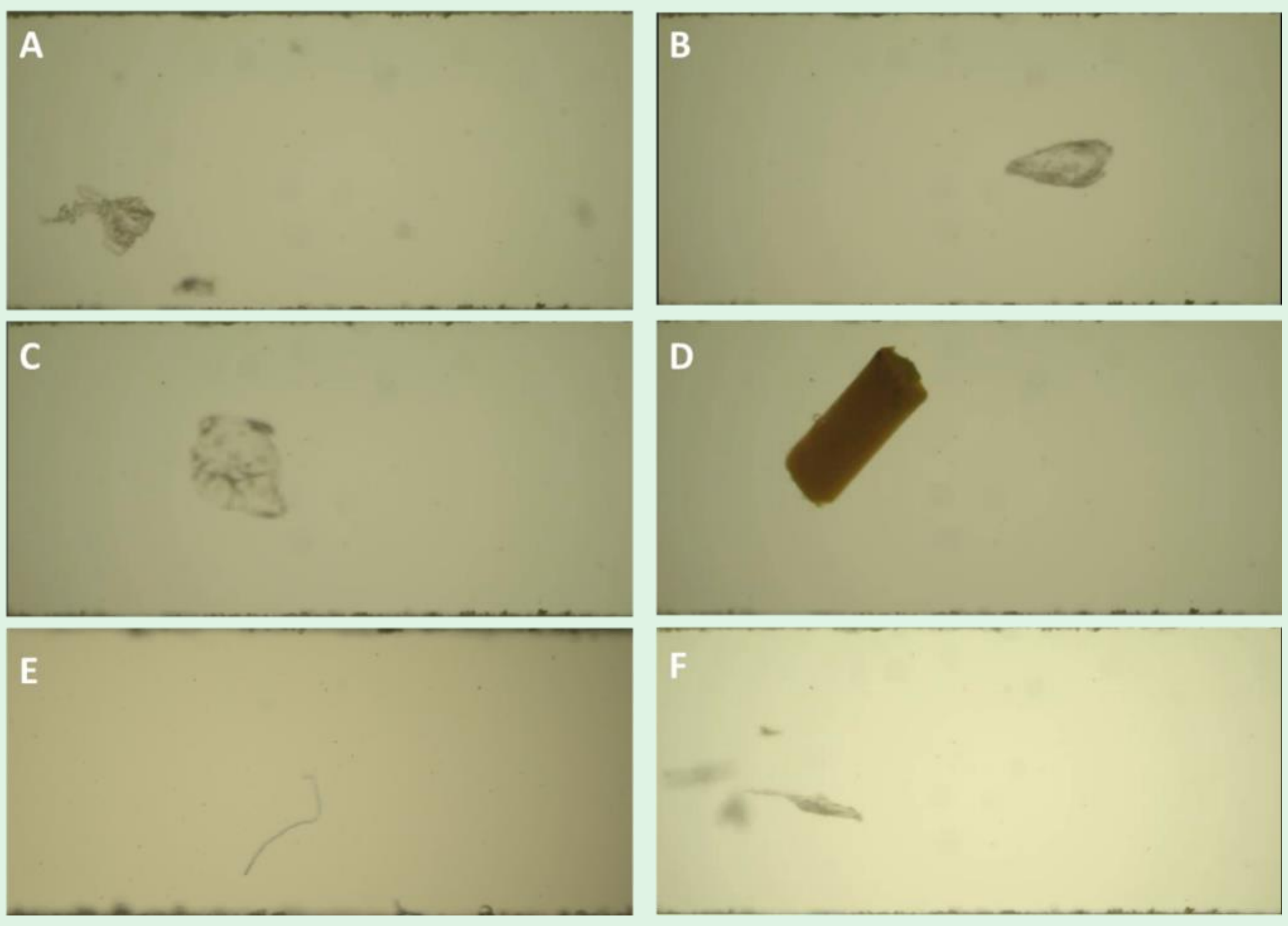
To address this threat, we introduce an innovative microplastic sensor [3] developed within the frame of ASTRAL, a European project that's aims to develop and provide innovative techniques and species combinations to improve Integrated Multi-Trophic Aquaculture (IMTA).

Sensor features

- **Compact Design**: 41 x 32 x 18 cm standalone device.
- **Advanced AI**: Convolutional Neural Network for accurate image segmentation and classification.
- **Continuous Learning:** AI improves accuracy over time.
- **Enhanced Detection**: Includes UV and visible light for fluorescence-based detection [4].
- **High Sensitivity:** Detects particles as small as 250 µm.
- **Custom Training**: Tailor-made microplastic dataset.
- **Superior Imaging:** State-of-the-art microscope objective.
- **Precise Fluid Handling:** Integrated peristaltic pump.
- **Durable and Waterproof:** IPX7-rated suitcase.

Results

The sensor was tested with real and synthetic samples under laboratory conditions at Leitat's facilities. Validation tests were subsequently conducted at IMTA's laboratory in Ireland to demonstrate the sensor's effectiveness in controlled environments. These tests confirmed its capability to accurately detect microplastics and distinguish them from other particles.4



Images taken during the validation of the microplastic sensor:

- A, B, and C correspond to polystyrene microplastics with sizes between 0.5 and 1 mm.
- D is an opaque plastic cylinder.
- E is a plastic microfiber.
- F shows an example of focused and non-focused particles

Conclusions

The microplastic sensor presented represents a significant advancement in environmental monitoring. Combining advanced optics, AI, and precision engineering, the sensor accurately identifies microplastics in water. This technology enhances understanding of microplastics distribution and its impact on ecosystems, adding in targeted mitigation strategies and preserving aquatic biodiversity.

References

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2. Rochman, C. M., et al., (2013). https://doi.org/10.1038/srep03263
3. Manuscript under preparation
4. Löder, M. et al., (2017) DOI: 10.1071/EN14205

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