Novel AI-Enhanced Sampling Techniques for Microplastic Detection in Aquatic Ecosystems

Veton Haziri
Avni Berisha
Shkëndije Sefa Haziri
University for Business and Technology, Kosovo, Prishtine 10000
veton.haziri@ubt-uni.net

Abstract

Microplastics (MPs) pose a growing threat to aquatic ecosystems, underscoring the need for more advanced detection techniques to assess their distribution and ecological impact[1]. This study presents a novel artificial intelligence (AI)-assisted methodology that enhances both the sampling and analytical processes involved in MP detection, addressing the shortcomings of conventional approaches[2]. A machine learning framework was developed, combining hyperspectral imaging with automated sampling systems to identify MPs in aquatic samples. The system utilizes convolutional neural networks (CNNs), trained on a dataset comprising 10,000 spectral profiles from various aquatic environments, to classify MPs based on size, polymer composition, and concentration. Field validation conducted in three European river systems yielded a detection accuracy of 92%, exceeding that of traditional Fourier-transform infrared (FTIR) spectroscopy by 15%. Moreover, the AI-guided sampling strategy reduced collection time by 30% through real-time predictive targeting[3]. The approach also offers scalability, facilitating integration with citizen science projects to support extensive monitoring efforts. Interference from organic materials was addressed through enhancements to the CNN's preprocessing functions. Future development aims to extend detection capabilities to include nano-plastics, further broadening the system's utility. This presentation will explore the potential of AI-powered environmental monitoring tools to advance interdisciplinary collaboration between scientists and policymakers.

Figure 1: Microplastics in water

References

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