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PlastoView - Microplastic detection algorithms for the PlastiScope

Microplastics, defined as plastic particles ranging from 1 micrometer to 5 millimeters, originate from the breakdown of larger plastic debris and synthetic textiles. These persistent particles proliferate throughout aquatic environments, presenting serious ecological and human-health concerns. Ingested by marine organisms, microplastics can enter human food chains, posing risks that underscore the urgent need for advanced detection and analysis methods.
Our project, introducing PlastoView, aims to address these challenges with an innovative imaging solution that leverages a polarization camera to exploit the distinct polarimetric signatures of microplastics versus plankton and other particulates. This technology exploits differences between microplastics and natural particulates like plankton. By capturing images at multiple polarization angles, we compute the degree and angle of linear polarization (DoLP and AoLP), significantly enhancing contrast and reducing noise through optimized filtering techniques. Polarization-enhanced feature maps are processed using an advanced deep-learning classification pipeline.
This approach involves comparing convolutional neural network architectures with classical machine learning baselines, facilitating robust, real-time identification of microplastic particles across diverse aquatic samples. Furthermore, our research seeks to create an open-source, scalable software platform tailored to polarimetric image processing. Publicly accessible, this toolkit is intended to empower researchers, environmental agencies, and other stakeholders worldwide to perform comprehensive, concurrent surveys of plankton and microplastics. The ability to conduct large-scale monitoring can greatly enrich our understanding of aquatic ecosystems. PlastoView will allow us to generate detailed, high-resolution maps illustrating microplastic distribution and material composition. These maps will provide critical data for pinpointing potential sources of pollution, informing the development of effective mitigation strategies. Our approach represents a significant step forward in the quantitative study of microplastic pollution. It holds promise not only for improving detection capabilities but also for advancing scientific insights into the prevalence and behavior of these pollutants within water bodies. By enhancing our ability to study and manage microplastic pollution, we aspire to contribute to the protection and preservation of marine ecosystems over the long term. This integration of novel imaging techniques with cutting-edge data processing solutions offers a practical path toward better environmental management and policy development. By understanding the nuances of microplastic distribution, we can make informed decisions aimed at mitigating their impact and safeguarding the health of our aquatic environments.

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