Lightwave Underwater Network for Microplastic Monitoring in Portugal

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Abstract:

The concept of "smart ocean" is rapidly gaining attention as the next frontier for the Internet of Underwater Things (IoUT). This advancement demands a radical rethinking of current sensing methods for unexpected underwater events and phenomena. As we venture into this new era, the need for reliable and time-sensitive information on both micro and macro hazardous particles becomes paramount. This is especially critical for various IoUT applications, where the timeliness of data collection can influence the trajectory of

observed events. While Non-Orthogonal Multiple Access (NOMA) has been effectively integrated into Visible Light Communication (VLC) systems, its application in underwater settings, especially in conjunction with Underwater Wireless Sensor Networks (WSNs), remains uncharted. Furthermore, the impact of light source power attenuation across different waterborne wavelengths has been largely overlooked. This project seeks to bridge these gaps by marrying NOMAVLC with communication between Autonomous Underwater Vehicles (AUVs) and floating vessels, aiming to augment spectral efficiency and aggregate transmission rates. Contrasted with the traditional Orthogonal Multiple Access VLC, our integrated approach promises enhanced throughput for data processing hubs. Crucially, we'll be resorting into the Age of Information concerning underwater NOMA-VLC links, a crucial metric yet untouched by both acoustic and VLC-based IoUT studies. The ubiquity of microplastics (MPs) in natural water bodies has positioned it as a global concern. These contaminants, which affect almost every aquatic species and, by extension, humans, necessitate vigilant monitoring. Current solutions like portable MP systems and remote sensing are still in nascent stages. This project, therefore, will focus on a critical aquatic organism found across marine, fresh, and brackish waters, aiming to gauge the repercussions of MPs on these species. Furthermore, the surge in algal blooms, particularly harmful algal blooms (HABs), poses considerable ecological and economic threats globally, with Portugal being no exception. Addressing this necessitates an intricate blend of fieldwork, lab analyses, and continuous monitoring. These blooms, intertwined with climate change and nutrient pollution, underscore the urgency for comprehensive research and conservation initiatives. Thus, our project will harness underwater event cameras and VLC-based methodologies to delve into Portugal's algal bloom dynamics. Moreover, we aim to concurrently assess the state of MP pollutants, algal blooms, and gauge the energy and entropy balance of Portugal's marine waters using a blend of experimental techniques.