Cost effective hyperspectral imaging for in-situ seagrass monitoring

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Seagrass meadows are highly productive coastal habitats that store carbon, support marine life, and protect shorelines. However, these ecosystems are increasingly affected by environmental pressures and diseases such as Seagrass Wasting Disease (SWD), which damages plant tissues and can lead to large scale habitat decline. Monitoring these changes in-situ remains challenging, as existing approaches, such as satellite-based observations often lack the spectral and spatial resolution required for finer scale analyses and are limited in underwater environments.

This work presents a cost effective, smartphone-based hyperspectral imaging system (ChromaMapper) as an accessible alternative for the in-situ monitoring of seagrass health. The instrument captures wavelengths across the visible and near-infrared (400 – 950 nm), utilising a handheld pushbroom scanning approach enabling portable field-based data collection. Building on successful laboratory validation, the instrument was deployed in the southern Maldives where measurements were acquired from submerged plants and from freshly collected samples.

Results demonstrate that the instrument can accurately resolve spectral differences between healthy and disease-affected tissue, including subtle features associated with SWD that are difficult to detect visually. Despite the challenges of underwater acquisition, key differences in plant condition remain clear, highlighting the robustness of the approach.

These findings demonstrate the potential of cost effective hyperspectral instrumentation to deliver high-resolution spectral data in field environments, supporting scalable and accessible monitoring of coastal ecosystems where traditional approaches may be impractical or unavailable.