The development of novel techniques for the characterisation of marine zooplankton over very large spatial scales. University of Plymouth, 1997.

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Marine zooplankton play an important role in the transfer of CO_2 from the atmosphere/ocean system to deeper waters and the sediments. They also provide food for much of the world's fish stock and in some areas of the ocean depleted of nutrients they sustain phytoplankton growth by recycling nutrients. They therefore have a profound effect on the carbon cycle and upon life in the oceans. There is a perceived lack of information about global distributions of zooplankton needed to validate ecosystems dynamics models, and the traditional methods of survey are inadequate to provide this information. There is a need to develop new technologies for the large scale survey of zooplankton, which should provide data either suitable for quick and easy subsequent processing, or better still, processed in real time.

New technologies for large scale zooplankton survey fall into three main categories: acoustic, optical and video. No single method is capable of providing continuous real time data at the level of detail required. A combination of two of the new technologies (optical and video) has the potential to provide broad scale data on abundance, size and species distributions of zooplankton routinely, reliably, rapidly and economically. Such a combined method has been developed in this study. The optical plankton counter (OPC) is a fairly well established instrument in marine and freshwater zooplankton survey. A novel application of the benchtop version of this instrument (OPC-1L) for real time data gathering at sea over ocean basin scales has been developed in this study. A new automated video zooplankton analyser (ViZA) has been designed and developed to operate together with the OPC-1L. The two devices are eventually to be deployed in tandem on the Undulating Oceanographic Recorder (UOR) for large scale ocean survey of zooplankton.

During the initial development of the system, the two devices are used in benchtop flow through mode using the ship's uncontaminated sea water supply. The devices have been deployed on four major oceanographic cruises in the North and South Atlantic, covering almost 40,000 km. of transect. Used in benchtop mode, it has been shown that the OPC can simply and reliably survey thousands of kilometres of ocean surface waters for zooplankton abundance and size distribution in the size range 250μm to 11.314um in real time. The ViZA system can add the dimension of shape to the OPC size data, and provide supporting data on size distributions and abundance. Sampling rate in oligotrophic waters, and image quality problems are two main limitations to current ViZA performance which must be addressed, but where sufficient abundance exists and good quality images are obtained, the initial version of the ViZA system is shown to be able reliably to classify zooplankton to six major groups.

The four deployments have shown that data on zooplankton distributions on oceanic scales can be obtained without the delays and prohibitive costs associated with sample analysis for traditional sampling methods. The results of these deployments are presented, together with an assessment of the performance of the system and proposals for improvements to meet the requirements specified before a full *in-situ* system is deployed.