SENSING TECHNOLOGIES FOR MONITORING MARINE ENVIRONMENT

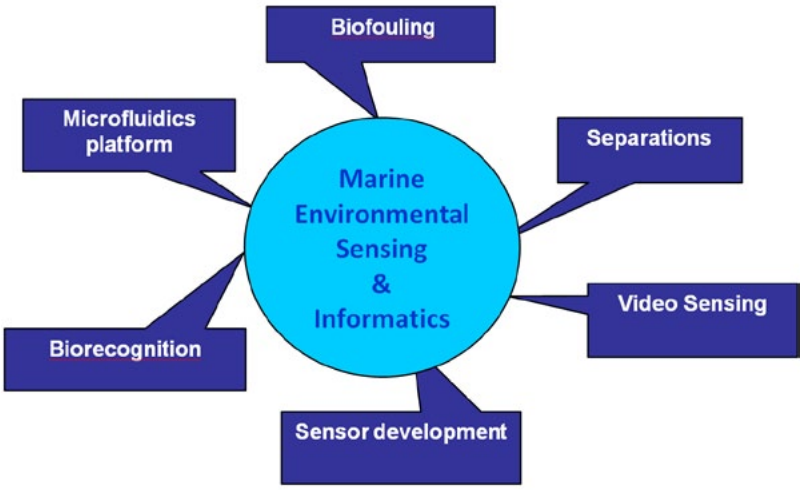
King Tong Lau, Dermot Diamond, Fiona Regan
Marine and Environmental Sensing Technology Hub (MESTECH)
National Centre for Sensor Research
Dublin City University

The lack of affordable, self-sustaining platforms for monitoring marine water quality means that measurements are done primarily through grab sampling at a limited number of locations and time, followed by analysis back at a centralised facility. This has resulted in huge gaps in our knowledge of water quality. This project aims to develop platforms capable of remote sampling and analysis over extended periods of time. This would provide the building blocks for establishing an 'environmental nervous system' comprised of many distributed sensing devices that share their data in near real-time on the web. The envisaged 'environmental nervous system' allows marine environment to be closely monitored, enabling the early detection of pollution events to minimise the danger to people and contamination of distribution systems.

This work is undertaken by the Marine and Environmental Sensing Technology Hub (MESTECH) which is formed by a multidisciplinary team of researchers with expertise in analytical science, sensor development, and visual imaging to the development of innovative technology solutions for the marine environment. This project is part of a marine focus initiatives called Beaufort marine research awards funded under the Marine Research Sub-Programme of the Irish National Development Plan 2007–2013. These awards anticipate to significantly develop overall Irish research capacity with a view to positioning Ireland's marine sector within a global knowledge-based economy.

This paper presents the technological developments that are essential for deployable sensing systems for monitoring marine water quality such as water turbidity, nutrient level, toxic algae etc within this Beaufort Marine research project. Important challenges associated with field-deployable sensors in marine environment are addressed. These include biofouling, wireless communications, data handling & analysis and power management etc. Research works involved are summarised below and shown in Figure 1:

- Anti- biofouling surface – Inspired by nature, synthetic surfaces with anti-fouling properties were developed by mimicking the surface micro structure of living marine creature such as shark and crab.
- Micro-separation technologies for simultaneous separation and detection of multiple target species within marine samples – low pressure micro column packed with surface modified monoliths were developed for rapid separation of ions and heavy metals.
- Sensor network based on visual sensing to monitor the coastal marine environment – Powerful tool for environmental monitoring can be realised by using camera based sensing technology combined with weather information readily available. Monitoring of eustuary/ river water level combining information such as rainfall, temperature….etc. gives accurate prediction of water level and can be used as warning system for flooding.
- Develop highly stable and specific antibodies for detection of marine based biotoxins – Novel antibodies for biotoxin were developed for bioassay.
- Microfluidics based autonomous instrument for nutrient analysis – Autonomous wireless nutrient analyser based on microfluidics has been developed for long term field deployment (see Figure 2). This instrument is the centre piece where other sensing techniques would be incorporated in the future to realise multi-analyte analyser.
- Low cost optical sensing devices for water quality monitoring – LED based sensor for colour and turbidity measurement.



(left) Figure 1. The Beaufort project adopts an integration approach for developing marine sensing network.

(right) Figure 2. Microfluidic based autonomous nutrient analyser.