Submersible Lidar for Seafloor Inspection

S. Harsdorf, S. Tönebön, R. Reuter & B. Wachowicz
Carl von Ossietzky Universität Oldenburg, D-26111 Oldenburg

M. Janssen & R. Willkomm
TriOS GmbH, D-26135 Oldenburg

Abstract

The German Bight is one of the coastal zones with the highest ship traffic in the world. Even though the German Ministry of Transport pursues a complex and comprehensive surveillance system for accident prevention in cooperation with other littoral states of the North Sea, oil pollution and chemical contamination may occur because of ship accidents and illegal discharges. Pollutants floating on the sea surface are easily detectable aboard a ship or with remote sensing. Other types of chemicals transported at sea mix with water and are rapidly dispersed, or sink to the seafloor because of their higher density and low solubility, e. g. halogenated compounds. The variety of substances and their properties and of the individual water bodies and their characteristics, on the other hand, requires a number of strategies for different situations, e.g. the development and application of several complementary sensors and methods for the detection of chemicals in the sea. Further, accidents of ships with chemical cargo may not always lead to an immediate, direct release of chemicals. Containers may be damaged, get lost, and sink to the ground. In order to guarantee a safe recovery, they first have to be inspected in detail, and the possible escape of substances has to be verified.

To make available the technical means for counteracting such events, it has been decided by the German Ministry for Research and Technology to develop a remotely operated vehicle (ROV) equipped with instruments for localising and analysing chemical pollutants in the water column and on the seafloor. It is intended to operate this system on board the multi purpose vessel “Neuwerk” of the Ministry of Transport in the German Bight. Because of the vast number of possible scenarios, the system consists of several sensors using various chemical and physical principles. In addition to basic sensors such as underwater video cameras and probes for measuring seawater temperature, conductivity and pH, the payload includes several newly developed instruments:

- a lidar for the inspection of the seafloor, which combines an ultrafast camera for an contrast-enhanced imagery of objects with a time-resolved fluorometer for substance classification (Carl von Ossietzky Universität, marine physics group),
- an acoustic sensor for measuring the acoustic impedance of the seafloor/water column interface which depends sensitively on the presence of surface films such as non-mixing chemicals spread on the ground (Carl von Ossietzky Universität, acoustics group),
- a membrane induction/gas chromatograph/mass spectrometer (Technische Universität Hamburg-Harburg), and a
- quartz microbalance sensor array, both suitable for sensitive measurements of substances mixing with water, and sinkers on the seafloor that produce plumes with low concentrations of chemicals (RST Raumfahrt und Umweltschutz GmbH, Rostock / Universität Magdeburg).

Prototypes of these sensors have been realised and successfully operated within the frame of the submersible sensor network. Their layout and experimental results will be presented with emphasis on the submarine lidar, and the use of the system for maritime surveillance are outlined

References:

S. Harsdorf, M. Janssen, R. Reuter, S. Tönebön, B. Wachowicz & R. Willkomm, 1999: Submarine lidar for seafloor inspection. Measurement Science and Technology, 10, 1178 - 1184

Gereit, F., P. Hauptmann, G. Matz, V. Mellert, R. Reuter, 1998: An ROV-based sensor system for maritime pollution control. Oceanology International 98 Conference Proceedings, Brighton, March 1998, Conference Proceedings Vol 2, 55-68