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In deep with marine environmental surveys

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Studies of seabed algae and sandbanks have shown the potential of using autonomous sensors for environmental monitoring. SUMARE has proven them to be more efficient, cost-effective and accurate.

Led by the Management Unit of the North Sea Mathematical Models at the Royal Belgian Institute of Natural Sciences, one of the tasks of this IST programme-funded project was to map maerl, a calcareous alga which forms large deposits or 'beds' on the seabed of Brittany, the North Sea and Ireland. It has a variety of commercial applications including as a soil fertiliser and as a treatment for reducing the acidity of drinking water.

It is currently extracted from the seabed in large volumes, though around the UK activity has slowed due to conservation concerns as a habitat for a large number of other algae and other sealife, such as scallops.

From a conservation and economic viewpoint, little is known about the spatial distribution of maerl. Traditional maerl survey techniques relied on a combination of dredge survey and sampling techniques. While effective at gathering detailed information at specific locations, they cannot

deliver information on larger scale attributes such as the distribution of living and dead material. To do so requires massive investment of time and finance, making such methods impractical and uneconomic.

But detailed mapping of maerl beds helps identify dead maerl. This is commercially important since its extraction is preferred as it has less associated organic material, and so requires less processing before sale. As project member, Alain Norro from the Royal Belgian Institute of Natural Sciences explains: "by focusing on dead mearl, living areas are undisturbed and left to grow, so that ultimately the crop of dead maerl can be sustained."

Video classification

One of the innovative elements of SUMARE was the development of an image classification algorithm which can classify video footage of maerl recorded as the video camera passes over the seabed. The algorithm has been developed to recognise living maerl, dead maerl, sand and macroalgae, at a variety of altitudes off the seabed and is fully automatic - the sensor learns statistical models that describe the relevant characteristics of the observed field.

Whilst classification of images may previously have been possible using raw video footage and skilled eye assessment, the SUMARE image classification algorithm is more objective, accurate and repeatable, as well as being automatic. This is considerably more efficient when collecting information on the physical characteristics. The ability to concentrate resources on mapping the most relevant features leads to considerable savings in survey costs whilst improving the results.

Another element of the approach taken by the SUMARE project relates to ‘information guidance’ and represents a transfer of control of the surveying operation from the user to the autonomous underwater vehicle (AUV), again saving time and money. Instead of travelling along a predetermined path the AUV periodically alters its route to maximise data collection in line with the observation goals, as the distribution of the surveyed object is rarely uniform.

Exploiting sandbanks

The other application tested by SUMARE, relates to government-sanctioned offshore exploitation of sand on the Belgian continental shelf. However, there is concern that growing exploitation could lead to a reduction in size - or even disappearance - of the banks. In turn this could affect water currents and erosion/sedimentation characteristics of the area, and lead to undesirable impacts on the nearby beaches.

As such the Flemish sandbanks have been subject to monitoring for several years. Traditionally, depth measurements are done by ships equipped with hydrographical instruments. But that is time-consuming, expensive (at a cost of €10,000 per day per ship) and at low tide, navigating the banks can be difficult. Mini-autonomous underwater vehicles, as demonstrated by SUMARE, offer a practical, more efficient and cheaper alternative.

SUMARE’s intensive data collection and analysis has shown that human activity

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on the sandbank could have had an impact on the shape and size of the sandbanks over previous years. However without further detailed analysis, the question of sustainability of the activity remains unanswered. Norro adds: "What is certain is that further investigation supported by intensified monitoring by AUVs, based on the SUMARE design, will form a key contribution," since it enables a faster and more cost-effective answer to be reached.

Potential for other marine surveys

As Norro points out, there is tremendous potential: "the approaches, algorithms and methodologies used by the team are platform independent, all the visual tracking, spatial statistical modelling and video segmentation research can be used on other platforms such as more powerful underwater vehicles."

The team believe that their techniques could be applied to a variety of marine survey tasks where the focus of study involves a feature with distinct visual attributes. In practice, according to the UN's Environment Programme's coral reef expert, Emily Corcoran, "this could involve other seabed habitats, such as seagrass beds, reefs and more simple bedrock outcrops," especially important when "the livelihood of one billion people worldwide depends on reefs." In addition, the sensor-driven guidance systems are of potential interest in pollution surveillance, and the detection and localisation of underwater mines.

Future work for the project team members will focus around further commercialisation of SUMARE's techniques and their application to a wider range of environmental surveying and monitoring situations.

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http://istresults.cordis.lu/index.cfm?section=news&tpl=article&ID=65150

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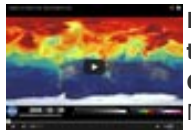

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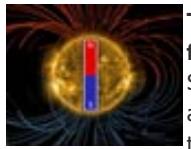

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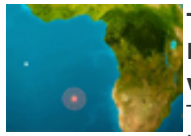

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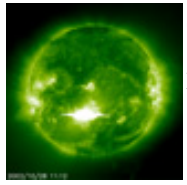

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