Development and Test of an AUV for Asset Integrity and Environmental Monitoring in Offshore Oil and Gas Scenarios

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ABSTRACT

The use of Autonomous Underwater Vehicles (AUV) is an emerging technology in many fields of marine activity (military, scientific, industrial), offering a significant potential in cost savings and extension of the operational capabilities associated to the solutions presently adopted in offshore operations. Commercially available AUVs are mainly used by the oil&gas industry for the execution of seabed surveys; however AUVs are normally not conceived for the execution of asset integrity and environmental monitoring tasks around oil&gas offshore infrastructures.

CLEAN SEA (Continuous Long-term Environmental and Asset Integrity monitoring at SEA) is the concept of an innovative robotic system making the execution of asset integrity and environmental monitoring tasks around oil&gas installations possible by means of a commercial AUV properly upgraded with key enabling technologies. The concept is based on the original and distinctive idea of an autonomous underwater vehicle capable to support a custom-designed mission payload, arranged in modular and interchangeable pods.

Another peculiar aspect is the extension of the AUV operational capabilities through the integration and field demonstration of key technologies such as underwater docking, wireless underwater communication for mission data downloading and wireless power recharge for increased autonomy. This may enable a “permanent” operation undersea independently of support from surface.

This paper provides a comprehensive technical overview of the concept. Results of the first phase of demonstration tests are also presented and discussed.

KEY WORDS: Environmental Monitoring, Asset Integrity, AUV, oil&gas, offshore.

INTRODUCTION

Presently, environmental monitoring and inspection tasks around oil & gas infrastructures are based on periodic surveys (typically on a yearly basis) involving the use of supply vessels and underwater equipment (like water/sediment samplers and ROVs) operated by dedicated personnel. When moving from traditional (for example conventional platforms in shallow water) to new and more challenging development scenarios (for example subsea production systems in remote, hostile and environmentally sensitive areas), the conventional methods may not be sufficient to ensure a safe and sustainable presence at sea. At the same time, it is widely recognized that underwater technology offers new and interesting opportunities for the development of advanced solutions able to ensure continuous, long-term, automatic execution of monitoring and inspection tasks at sea. In particular, AUVs are an emerging technology in many fields of marine activity (military, scientific, industrial), offering a significant potential in cost savings and extension of the operational capabilities associated to the solutions presently adopted in offshore operations.

However, no AUV is presently conceived for the execution of the asset integrity and environmental monitoring tasks required by the oil&gas industry. Technological gaps can be summarized as follows:

- commercially available AUVs (like Hugin and Remus) used by the oil&gas industry are designed for seabed surveys only
- inspection/intervention AUVs are at prototype or even conceptual development stage; only pipeline surveys have been accomplished by few AUVs suitably equipped
- no AUV can be configured “in field” and at the moment it is necessary to use a different tool (dedicated ROV, dedicated AUV etc.) for each different task (monitoring, mapping, surveying) to be accomplished
- limited autonomy of operation (in the order of twenty hours) does not allow AUV to operate "permanently" at site, independently from surface support.

Recognizing these needs and technological gaps, in October 2011 eni e&p division and its subsidiary eniNorge, in cooperation with tecnomare, have launched CLEAN SEA project, with the aim of extending the capabilities of the autonomous robot technology, providing a fully operative solution serving the oil&gas industry asset integrity and environmental monitoring requirements.

TECHNICAL DESCRIPTION

The concept (shown in Figure 1 and Figure 2) is based on the original and distinctive idea of an autonomous underwater vehicle equipped with a modular interchangeable payload.

The system is also characterized by a peculiar hardware and software architecture, where the payload controller is separate from the AUV controller and capable of modifying “in real time” the mission strategy.