Underwater Laser Scanning: Integration and Testing in different environments

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SUMMARY

Facing the worldwide expansion of underwater infrastructure elements such as port facilities, offshore wind turbines, pipelines, submarine cables and drilling platforms, which all require regular inspection, maintenance and repair operations, the demand for a fast, precise and high-resolved monitoring solution becomes present. Subsequently, technologies which are able to detect deformations in the range of millimetres, indicating damage at an early stage, are required.

Since optical technologies such as digital cameras, used by divers or mounted on underwater vehicles, are very cost- and labour-intensive and since acoustic systems measure comparably slow and inaccurate, providing only a resolution in the range of centimetres, LiDAR technologies provide a promising alternative.

By means of that, underwater laser scanning systems are capable to achieve a much higher accuracy and measurement speed than acoustic techniques and thus deliver enormous potentials.

However, since water presents physical difficulties to optical systems in terms of turbidity and reachable distance, up to date, only sparse information regarding the performance of an underwater laser scanner and only view estimates about to the actual usability of such a system for corresponding monitoring purposes, are available.

With the purchase of the underwater laser scanner ULi, which was developed by the Fraunhofer IPM, this subject is to be changed. Subsequently, it must be determined to what extent the technical details provided by the manufacturer, especially with regard to the achievable resolution, can be reproduced in different test environments.

In this context, especially the influence of various environmental parameters such as turbidity and the occurrence of currents as well as waves , combined with the measurement onto different objects with varying surface characteristics and roughness's, is examined. Therefore, tests in different environments, including test tanks in laboratories, are carried out. By changing the environmental influences and placing objects made out of different materials into those test basins as well as changing the distance between the scanning system and those objects, the resilience of the system and its performance under different conditions can be examined.

To make a final estimation about the resolution and the accuracy which can be achieved under different test scenarios, a Böhler-Stern as well as known reference surfaces will be used and placed into the test basins. Last but not least, the reachable precision will be elaborated by carrying out repetitive measurements.

Based on the results of the tests carried out, it can be assessed to which extend the technical specifications of the manufacturer can be meet and finally to what potential degree the usage of the ULi is suitable for realistic underwater applications. Subsequently, a rough estimate whether the system can be used for monitoring tasks by meeting the associated requirements, can be given.