

A new compact cost-efficient concept for underwater range-gated imaging: The UTOFIA camera

Quincoces Iñaki¹, Mariani Patrizio², Gabiña Gorka¹, Visser Andy², Jónasdóttir Sigrun², Haugholt Karl Henrik³, Thorstensen Jostein³, Risholm Petter³ and Thielemann Jens³

¹ AZTI, Isla de Txatxarramendi s/n, 48395 Sukarrieta, Spain

E-mail: iquincoces@azti.es

² National Institute for Aquatic Resources, Technical University of Denmark, Charlottenlund, Denmark

³ Optical Measurement Systems and Data Analysis, SINTEF, Oslo, Norway

Underwater Time of Flight Image Acquisition system (UTOFIA) is a H2020 project launched in 2015 (H2020- 633098) to develop a compact and cost-effective underwater imaging system especially suited for observation in turbid environments.

The UTOFIA project targets technology that can overcome the limitations created by scattering, one of the most common problems for imaging in water, by introducing cost-efficient range-gated imaging for underwater applications. This technology relies on an image acquisition principle that can extend the imaging range of the cameras 2-3 times in respect to other cameras. Moreover, the system will simultaneously capture 3D information of the observed objects. Today range-gated imaging is not widely used, as it relies on specialised optical components making systems large and costly. Recent technology developments have made it possible a significant (2-3 times) reduction in size, complexity and cost of underwater imaging systems, whilst addressing the scattering issues at the same time.

By acquiring simultaneous 3D data, the system allows to accurately measure the absolute size of marine life and their spatial relationship to their habitat, enhancing the precision of fish stock monitoring and ecology assessment, hence supporting proper management of marine resources. Additionally, the larger observed volume and the improved image quality make the system suitable for cost-effective underwater surveillance operations in e.g. fish farms, underwater infrastructures. The system can be integrated into existing ocean observatories for real time acquisition and can greatly advance present efforts in developing species recognition algorithms, given the additional features provided, the improved image quality and the independent illumination source based on laser.

First applications of the most recent prototype of the imaging system will be provided including inspection of underwater infrastructures and observations of marine life under different environmental conditions and its comparison with conventional cameras.

Keywords: Time of Flight camera; ToF; 3D vision; aquaculture biomass estimation; vision in turbid environments