Advanced spectro-bathymetric mapping of shallow seafloor using UAV imagery and deep learning tehniques

Evangelos Alevizos[1], Vassilis C. Nicodemou[2], Alexandros Makris[2], Iason Oikonomidis[2], Anastasios Roussos[2] and Dimitrios D. Alexakis[1#*]

[1] Geophysics - Satellite Remote Sensing & Archaeoenvironment (GeoSat ReSeArch Lab), Institute for Mediterranean Studies, Foundation for Research and Technology - Hellas (FORTH) Nikiforou Foka 130 & Melissinou, P.O. Box. 119, Rethymno 74100, Crete, Greece

[2]Computational Vision and Robotics Laboratory, Institute of Computer Science, Foundation for Research and Technology - Hellas (FORTH), N. Plastira 100, Vassilika Vouton, GR-700 13 Heraklion, Crete, Greece

Presenting author: Dimitrios Alexakis, email:dalexakis@ims.forth.gr
* Corresponding author: Dimitrios Alexakis, email: dalexakis@ims.forth.gr

ABSTRACT

The shallow coastal seafloor remains highly uncharted posing a significant gap between land-based and marine mapping applications. Covering depths between a few centimetres and up to 10 meters, shallow waters encompass various seafloor types, with different grades of complexity offering host to multitude of habitats [1]. Recent studies apply either spectral or photogrammetric techniques for deriving bathymetry from drone-based data. However, spectral methods require a certain amount of ground-truth depth data for model calibration while photogrammetric methods cannot perform on smooth seafloor types. The presented approach has been carried out in the frame of ACTYS project and takes advantage of the interrelation of the two methods, in order to predict bathymetry in a more efficient way.

This project has a clear interdisciplinary character, featuring: UAV technology and geodesy, mul_-spectral imaging, 3D computer vision, machine learning, geo-statistics and Geographic Information Systems (GIS) for seafloor mapping. Thus, we combine structure-from-motion outputs along with band-ratios of radiometrically corrected drone images within a deep learning workflow. Interpolated Unmanned Surface Vehicle (USV) sonar measurements are utilized for training. We perform several predictions using convolutional neural networks (CNNs) at three coastal areas in Crete, with varying seafloor types. In addition, we test the performance of each model by using different training sizes, and additionally by using one study area as training set and the rest as test areas. Our results show lowest root-mean-square errors (RMSE<0.4m) when 60% of the ground truth data are used for training. Furthermore, areas with mixed seafloor types are suitable for building a model that can be applied in similar locations where only drone data is available.

REFERENCES

[1] Kenney, A. J., Cato, I., Desprez, M., Fader, G., Schu_enhelm, R. T. E., Side, J. An overview of seabed-mapping technologies in the context of marine habitat classifica□on. **ICES Journal of Marine Science**, 60: 411–418, (2003).