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An automated Unmanned Aerial Vehicle – Structure from Motion pipeline to create analysis-ready Digital Surface Models for coastal monitoring

Anthropogenic pressure on coastal areas continues to increase, thus intensifying coastal erosion. Coastal monitoring programs are therefore essential to prevent severe ecosystem and economic consequences. Successful coastal monitoring schemes require highly accurate analysis-ready Digital surface models (DSMs) derived using the same workflow.

Using a Unmanned Aerial Vehicle – Structure from motion (UAV-SfM) approach allows for a cost-efficient, automated approach ensuring repeatability. Image segmentation is used to create water masks automatically, and an algorithmic approach to identify and import GCPs was developed. While most literature features a semi-automatic approach, this pipeline presents a workflow that allows for a fully automated DSM generation from UAV images. An image segmentation model (VGG-Segnet) is trained to automatically identify water and land areas in the UAV images resulting in a pixel accuracy of 90%. Ground control points (GCPs) are automatically identified using only the RGB images of the UAV by differentiating pixel clusters by color, size, and shape, as well as relative position.

While the outcome was not flawless and the markers were not always placed perfectly in the center, the approach showed high potential to be developed further. The study further shows the importance of using appropriate settings in Agisoft Metashape. Settings are likely to depend on equipment and study area. However, some insight into the effect of settings on the alignment quality is presented. The DSMs created in this study achieved an RMSE of 3 - 4 cm, proving a very high accuracy. Further analysis showed that this error is likely to be underestimated due to the poor distribution of check points.

Keywords: Physical geography, ecosystem analysis, geomatics, GIS, UAV, structure-from-motion, machine learning, coastal monitoring

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