Assessment of Classification Methods based on Structure from Motion Point Clouds for monitoring dynamic River Environments

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Surveying methods for monitoring rivers traditionally rely on tedious field work. Such point or line sampling however does not fully illustrate these dynamic environments in their temporal and spatial heterogeneity. Data representing the “riverscape” at high resolution is in increasing demand to assess geomorphic dynamics, flow hydraulics, in-stream habitat and other process-oriented investigations. Parallel advancements in light-weight, small-scale unmanned aerial systems (UAS) and photogrammetry using Structure from Motion (SfM) algorithms have resulted in an explosion of uses for inexpensive and easily obtained remotely sensed data. Here point clouds, the primary output of a SfM approach, are evaluated for their potential to provide data towards holistic monitoring of rivers. Point clouds utilized in this study stem from the Remotely Piloted Aircraft multi Sensor System (RPAmSS), a small-scale UAS equipped with a consumer grade camera for 2D and 3D mapping.

For two different river systems, both subject to the EU-LIFE restauration project, multispectral imagery was acquired at hyperspatial resolutions (<0.1m) and point clouds were photogrammetrically derived. First, the point clouds were referenced to address observed shifts in their absolute location. Further preprocessing steps include subsampling and noise filtering. Five classification and ground filtering methods were applied and assessed for their performance on SfM point clouds.

Results show that the proprietary software LAStools offered the overall best functionality. The open-source Cloth Simulation Filter was identified as fast and reliable bare-earth extraction tool. Further results are the workflow for the calculation of ratio based indices on point clouds using merged RGB and NIR data. Finally the submerged bathymetry was estimated considering the refraction of water. Compared to sonar cross sections underwater topography was derived at RMSE = 0.33m before and RMSE = 0.19m after refraction correction.