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Airborne Laser Scanning as geometric basis for Hydraulic Models

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Due to recent flood events, the definition of endangered or vulnerable areas based on numerical models of the water flow, has become a topic of highest public interest. The most influential input for such models is the topography provided as a Digital Terrain Model of the Watercourse (DTM-W).

In the last years Airborne Laser Scanning (ALS) has become a prime data source for capturing terrain data of inundation areas. It combines cost efficiency, high degree of automation, high point densities and good height accuracy. In addition, the laser signal is able to penetrate the vegetation through small openings. Therefore, ALS is particularly suitable for deriving precise Digital Terrain Models as geometric basis for Computational Fluid Dynamic (CFD) models.

To exploit the full information provided by ALS a complete processing chain from the raw ALS point cloud, via a precise DTM to the well-conditioned hydraulic grid has to be established. This requires thorough orientation of ALS-strip data, proper filtering of off-terrain points, correct fusion of ALS and additional river bed data and, finally, DTM interpolation including filtering of random measurement errors. An advanced approach for filtering ALS point clouds based on robust interpolation combining geometric criteria and additional echo attributes derived from full waveform data analysis is presented, improving the reliability of the classification and the quality of the DTM especially in low vegetation areas.

The higher point density provided by modern sensors leads to an increased amount of

DTM data. Thus, a direct use of the DTM-W as the geometric basis for CFD models is impossible. Currently available mesh generators for CFD models basically focus on physical parameters of the calculation grid like angle criterion, aspects ratio and expansion ratio. The detailed shape of the terrain as provided by modern ALS data is often neglected. A data reduction approach based on an adaptive TIN-refinement is presented, which considers both the physical aspects mentioned above as well as the preservation of relevant terrain details. The basic idea is to provide a spatially adaptive data distribution, where the terrain parts being important for the CFD model are mapped with more details than parts of minor importance.

Finally, practical results of CFD models based on different geometry variants are presented and discussed. It will be shown that a detailed description of the topography can be established in CDF models very well, resulting in more realistic flow simulations and more precise boundaries of potential flooding areas.