An approach for UAV-based DSM filtering using image classification and geometric constrains

Digital Surface Model (DSM) and the derived DEM constitute a basis for a number of applications such as tree extraction, digital canopy model generation, biomass estimation, landform modelling, orthophoto generation etc. DSM data generated using UAV imagery includes large amount of artefact and noise, which is resulted from poor quality image matching in imagery of non-metric cameras used in commercial systems. Furthermore, unlike urban and suburban areas where artefacts appear on building edges, forest and densely vegetated environments are notorious for producing erroneous matching results in the whole area mainly due to repetitive pattern of tree canopies and lack of distinct features required to produce good image matching result. As a result, geometric-based DSM filtering fails to produce high quality DEM during the filtering process.

In the literature, there are a few approaches that used image segmentation results to improve the quality of the DSM (Poli and Soille, 2012) with a focus on the building extraction application. In the natural environment, however, this approach cannot be used mainly due to diverse and complex shapes of natural features. In this research, an approach is proposed to make use of both spectral and geometric information to generate high quality DEM. First a supervised classification is performed to generate a mask to exclude the vegetated area followed by standard filtering techniques based on geometric constraints to filter the remaining above ground 3D point clouds. An example result is shown in Figure 1 where a labelled image (Fig 1-c) resulting from image classification has been used to remove the vegetation.

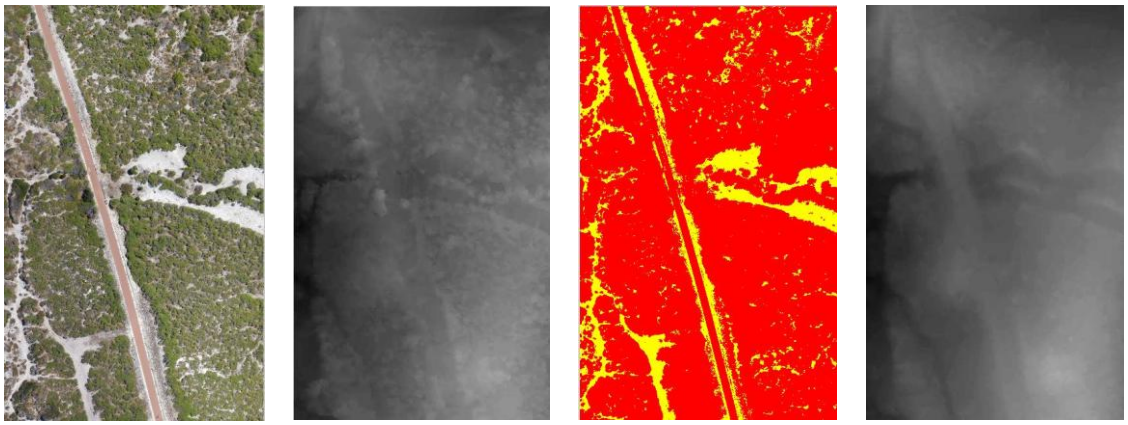

Fig.1: (a) Orthophoto (b) DSM (c) Labelled image (ground=yellow) (d) DTM

To visually assess the quality of the derived DEM, in Fig. 2, the DEM result with and without using spectral information is shown. The developed approach has been quantitatively assessed against LiDAR-derived DEM and quality measures are presented. The estimated quality indices show that our approach can produce significantly higher quality DEM in natural environment where dense vegetation of various types exists.

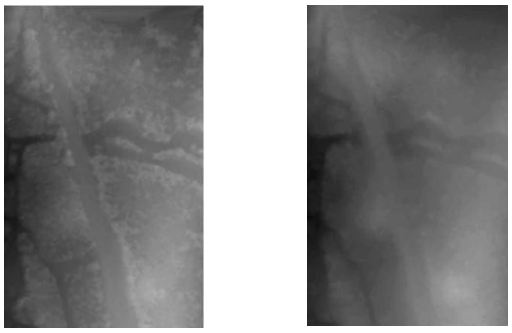

Fig. 2: Left: DTM without using spectral information; Right: DTM result when using spectral information.

Reference:

Poli, D. and Soille, P., 2012. Digital Surface Model Extraction and Refinement through Image Segmentation – Application to the ISPRS Benchmark Stereo Dataset, PFG (4), pp 317-330.