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Development of a 3D Viewer for georeferencing and monoplotting of historical terrestrial images.

Sebastian Flöry, Camillo Ressl, Gerhard Puercher, Norbert Pfeifer, Markus Hollaus, Andreas Bayr, and Wilfried Karel
Department of Geodesy and Geoinformation, TU Wien, Austria (sebastian.floery@geo.tuwien.ac.at)

Mountain regions are disproportionately affected by global warming and changing precipitation conditions. Especially the strong variations within high mountain ranges at the local scale require additional sources in order to quantify changes within this challenging environment. With the emergence of alpine tourism, terrestrial photographs became available by the end of 1800, predating aerial imagery for the selected study areas by 50 years. Due to the earlier availability and oblique acquisition geometry these images are a promising source for quantifying changes within mountainous regions at the local scale. Within the research project SEHAG, methods to process these images and to analyse their potential to quantify and describe environmental changes are developed and applied to study areas in Austria and Italy.

One of the prerequisites for the estimation of changes based on terrestrial imagery is the calculation of the corresponding object point for each pixel in a global coordinate system resulting in a georeferenced orthorectified image. This can be achieved by intersecting the ray defined by the projection center of the camera and each pixel with a digital terrain model, a process known as monoplotting.

So far 1000 terrestrial images with unknown interior and exterior orientation have been collected from various archives for the selected study areas Kaunertal, Horlachtal (both Tyrol, Austria) and Martelltal (South Tyrol, Italy). In order to estimate all camera parameters a 3D viewer for the selection of ground control points has been developed and implemented. The estimation of the exterior and interior orientation is done in OrientAL.

Preliminary results for selected images show, that especially the developed 3D viewer is an important improvement for the selection of well distributed ground control points and the accurate estimation of the exterior and interior orientation. Monoplotting depends on a digital terrain model, which cannot be computed from the terrestrial images alone due to missing overlap and different acquisitions times. Hence, the combination with historical digital terrain models derived from aerial imagery is necessary to minimize errors introduced due to changes in topography until today. While the large amount of terrestrial images with their oblique acquisition geometries can be exploited to fill occluded areas by combining the results from multiple images, the partly missing or inaccurate temporal information poses another limitation.

With this large image collection, for the first time, we are able to evaluate the use of historical oblique terrestrial photographs for change detection in a systematic manner. This will promote knowledge about challenges, limitations and the achievable accuracy of monoplotting within mountainous regions. The work is part of the SEHAG project (project number I 4062) funded by the Austrian Science Fund (FWF).