P-031

VISUALISING DEM-INDUCED UNCERTAINTY IN MEASUREMENTS FROM A SINGLE SIDE-LOOKING AERIAL IMAGE

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BACKGROUND AND OBJECTIVES

Horizontal location of an object may be derived from a single aerial image, if orientation of the image and digital elevation model (DEM) of the target area are available. For mapping purposes single image measurement becomes feasible, when data sources with higher level of accuracy are unavailable.

In this paper we present methods to calculate and visualise DEM-induced uncertainty of horizontal location in a measurement from a single side-looking aerial image. The aims of the paper are to 1) derive and implement calculation methods for defining horizontal location uncertainty of objects visible in a side-looking aerial image, when the image's exterior and interior orientation is assumed to be accurate and the uncertainty exists only due to imperfection of the DEM and to 2) demonstrate and evaluate alternative visualisation methods for the horizontal uncertainty.

APPROACH AND METHODS

Horizontal uncertainty of the object's location in a single image measurement is calculated using the position of the camera's projection centre, as well as the DEM of the target area and the metadata about the DEM uncertainty. As a result, magnitude and direction of the uncertainty can be defined for all parts of the image and they can be represented as the uncertainty surfaces. The objective of visualising the uncertainty surfaces is to provide a decision support for the user about making measurements of an object from an aerial image, in which the image geometry is optimal in terms of defining the object's horizontal location. The challenges in visualising the surfaces are to take care that the visualisation does not confuse the interpretation of the background imagery, the representations communicates efficiently about the magnitude and direction of the uncertainty and visual jumps in visualising the uncertainty surfaces at different scale levels are minimised.

RESULTS AND CONCLUSION

In the case study, several cartographic means for visualising the uncertainty surfaces are experimented. The methods include grid-based visualisations, as well as line and point symbol representations of the uncertainty surfaces. The visualizations are carried out on top of the ortho-rectified side-looking aerial image in the coordinate system of the map projection, and also on the top of the original digital photograph in the image coordinate systems. In the image coordinate system, the uncertainty surfaces are back projected using central projection and camera's exterior and interior orientation. The visualizations appeared to be an efficient method for communicating about DEM-induced uncertainty in measurements from a single side-looking aerial image and they help the operator to make measurements from an aerial image, in which the image geometry is optimal for the purpose.