Image Orientation via Stochastic Model Updating

Proposal for a Master thesis topic (EN)

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Image orientation is the task of estimating the exterior orientation parameters of an image in central perspective transformation and constitutes the foundation for many applications, such as traffic, agricultural and environmental monitoring. To address this task, most of the approaches in the literature rely on the identification of ground control points (GCPs) in the image, some also on the determination of point correspondences between the image and an orthophoto, i.e., a geo-referenced image. While the usage of GCPs requires that their object coordinates must be known, the usage of point correspondences is prone to mismatches and thus requires a large number of potential matches that are processed with a robust adjustment approach, such as M-estimator or RANSAC. When using a sparse set of feature points, as is usually the case, both approaches share the drawback that only a small portion of the actual image is used to carry out the orientation task, neglecting the majority of information provided by this image. Finally, such conventional image orientation approaches typically only consider aleatoric uncertainty, which describes stochastic effects. On the other hand, epistemic uncertainty, which accounts for simplifications or incorrect assumptions with respect to the formulated model hypothesis, is often neglected.

The objective of this master thesis is to investigate the applicability of stochastic model updating approaches to the task of image orientation, which would allow to estimate both, aleatoric and epistemic uncertainty. For this purpose, a method is to be developed that estimates the six parameters of exterior orientation of an aerial image together with their associated uncertainty using an orthophoto (see Fig. 1). The method should be based on Bayesian statistics to allow the consideration of prior knowledge for the exterior orientation. As basis for the experimental investigations, methodology and software can be used, which is available at the Institute for Risk and Reliability. However, the software needs to be adapted to the task of image orientation, which is to be accomplished as part of this thesis. To evaluate the method developed, the results are to be compared to those of conventional image orientation approaches and to reference data. No data needs to be acquired in the context of this thesis, all necessary data will be provided by the Institute of Photogrammetry and GeoInformation.

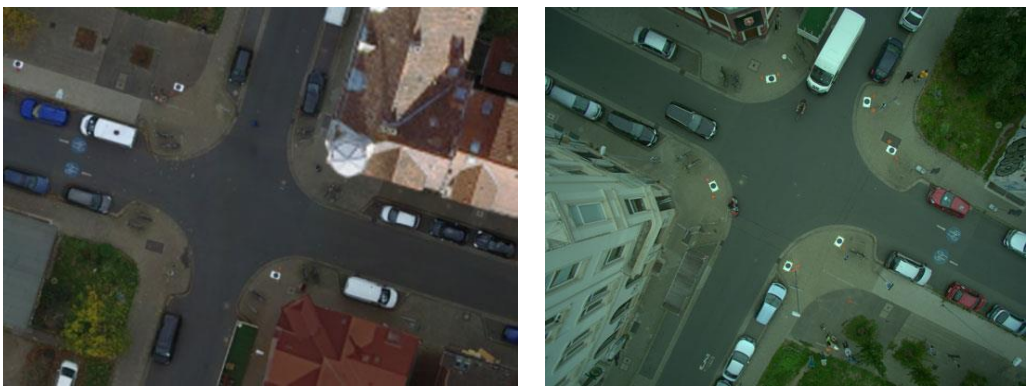

Figure 1: Example from the measurement campaign of the research training group i.c.sens in Hannover, showing an orthophoto (left) and an aerial image taken by a UAV (right) that both depict the same road intersection.