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A global approach for image orientation using Lie algebraic rotation averaging and convex L_∞ minimisation

M. Reich and C. Heipke
Institute of Photogrammetry and GeoInformation, Leibniz Universität Hannover, Hanover, Germany

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Abstract. In this paper we present a new global image orientation approach for a set of multiple overlapping images with given homologous point tuples which is based on a two-step procedure. The approach is independent on initial values, robust with respect to outliers and yields the global minimum solution under relatively mild constraints. The first step of the approach consists of the estimation of global rotation parameters by averaging relative rotation estimates for image pairs (these are determined from the homologous points via the essential matrix in a pre-processing step). For the averaging we make use of algebraic group theory in which rotations, as part of the special orthogonal group *SO(3)*, form a Lie group with a Riemannian manifold structure. This allows for a mapping to the local Euclidean tangent space of *SO(3)*, the Lie algebra. In this space the redundancy of relative orientations is used to compute an average of the absolute rotation for each image and furthermore to detect and eliminate outliers. In the second step translation parameters and the object coordinates of the homologous points are estimated within a convex L_∞ optimisation, in which the rotation parameters are kept fixed. As an optional third step the results can be used as initial values for a final bundle adjustment that does not suffer from bad initialisation and quickly converges to a globally optimal solution. We investigate our approach for global image orientation based on synthetic data. The results are compared to a robust least squares bundle adjustment. In this way we show that our approach is independent of initial values and more robust against outliers than a conventional bundle adjustment.