

[Volume XL-5](#)

Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XL-5, 385-393, 2014
www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XL-5/385/2014/
doi: 10.5194/isprsarchives-XL-5-385-2014

An Integrated Flexible Self-calibration Approach for 2D Laser Scanning Range Finders Applied to the Hokuyo UTM-30LX-EW

D. Mader, P. Westfeld, and H.-G. Maas
Institute of Photogrammetry and Remote Sensing, Technische Universität Dresden, Germany

Keywords: LIDAR, laser range finder, terrestrial laser scanning, error model, calibration, bundle adjustment, variance component estimation

Abstract. The paper presents a flexible approach for the geometric calibration of a 2D infrared laser scanning range finder. It does not require spatial object data, thus avoiding the time-consuming determination of reference distances or coordinates with superior accuracy. The core contribution is the development of an integrated bundle adjustment, based on the flexible principle of a self-calibration. This method facilitates the precise definition of the geometry of the scanning device, including the estimation of range-measurement-specific correction parameters. The integrated calibration routine jointly adjusts distance and angular data from the laser scanning range finder as well as image data from a supporting DSLR camera, and automatically estimates optimum observation weights. The validation process carried out using a Hokuyo UTM-30LX-EW confirms the correctness of the proposed functional and stochastic contexts and allows detailed accuracy analyses. The level of accuracy of the observations is computed by variance component estimation. For the Hokuyo scanner, we obtained 0.2% of the measured distance in range measurement and 0.2 deg for the angle precision. The RMS error of a 3D coordinate after the calibration becomes 5 mm in lateral and 9 mm in depth direction. Particular challenges have arisen due to a very large elliptical laser beam cross-section of the scanning device used.

[Conference Paper](#) (PDF, 4012 KB)

Citation: Mader, D., Westfeld, P., and Maas, H.-G.: An Integrated Flexible Self-calibration Approach for 2D Laser Scanning Range Finders Applied to the Hokuyo UTM-30LX-EW, Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XL-5, 385-393, doi:10.5194/isprsarchives-XL-5-385-2014, 2014.

[Bibtex](#) [EndNote](#) [Reference Manager](#) [XML](#)

