An Automatic Method for Adjustment of a Camera Calibration Room

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SUMMARY

Machine vision is becoming a part of our everyday lives. Measurements by cameras are a fundamental part of this automation process. During past few years revolution has taken place in the development of the camera technologies. High resolution multi-spectral sensors with highly accurate lenses are more accessible than any time. Such technologies also exist in many everyday use devices such as smart phones, DSLRs and tablets. In order to position the measurements by cameras, the geo-referencing is required. The basis of geo-referencing is the accurate calibration of internal parameters of a camera which involved focal length, principal point, radial/tangential distortions estimation. The determination of geometric characteristics of systems is becoming essential because different sensors have very different operating principles. FGI is investigating new aspects of camera calibration by developing a calibration room. The essence of accessing a camera calibration room to facilitate estimating a camera's internal-parameters suggests developing a fast and reliable approach for automatic calibration-room adjustment. Such a room could be employed to calibrate planar, multi-planar, fish-eye or multi fish-eye cameras. By the context of "automatic target adjustment" we mean estimating fixed targets with good spatial coverage in the local coordinate system of a calibration room with the possibility of automatic reading of their image observations in a short time (10-30 min). In this work we demonstrate such development for a calibration room by employing fixed-location coded-targets designed for good visibility in short range (30cm-4m). Our easy-to-read coded-targets ensure automatic and robust measurements of ties. A minimum-constraint block bundle-adjustment is employed to optimize the cost function and propagate errors from observations to unknowns. Our results demonstrate that the locations of targets are estimated with high precision (10-40 micron std.) in a distance of 30cm-4m. All object points are re-projected for residual investigation; sub-pixel image residuals are consequently observed for all coded-targets which ensure the quality of adjustment. Finally, repeated measurements (6 data sets) confirm the correctness of the proposed (95%) positional confidence intervals of the object points.