Simultaneous intrinsic and extrinsic calibration of a laser deflecting tilting mirror in the projective voltage space

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PURPOSEă : During the past five decades, laser technology emerged and is nowadays part of a great number of scientific and industrial applications. In the medical field, the integration of laser technology is on the rise and has already been widely adopted in contemporary medical applications. However, it is new to use a laser to cut bone and perform general osteotomy surgical tasks with it. In this paper, we describe a method to calibrate a laser deflecting tilting mirror and integrate it into a sophisticated laser osteotome, involving next generation robots and optical tracking. METHODSă : A mathematical model was derived, which describes a controllable deflection mirror by the general projective transformation. This makes the application of well-known camera calibration methods possible. In particular, the direct linear transformation algorithm is applied to calibrate and integrate a laser deflecting tilting mirror into the affine transformation chain of a surgical system. RESULTSă : Experiments were performed on synthetic generated calibration input, and the calibration was tested with real data. The determined target registration errors in a working distance of 150ămm for both simulated input and real data agree at the declared noise level of the applied optical 3D tracking system: The evaluation of the synthetic input showed an error of 0.4ămm, and the error with the real data was 0.3ămm.
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