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AUTOMATIC POINT CLOUD GENERATION AND REGISTRATION WITH A STEREOVISION SLIT-SCANNER

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Abstract. In this paper, a fully automatic 3D surface scanner, from point collection to point cloud registration and smoothing, is presented. The system is composed by a camera pair, which is calibrated automatically, and a hand-held laser plane. On epipolar images, generated from the stereo-frames taken as the object is being swept over by the laser plane, the search for point correspondences is reduced to identifying intersections of image rows with the recorded laser profiles. A variation of fitting Gaussian curves to the gray-value data along epipolar lines allows estimating peak positions by also using information from the vicinity of the peak. 3D reconstruction by simple stereovision is strengthened geometrically by imposing additional coplanarity constraints. All unknowns for a scanning po- sition are estimated simultaneously in a single iterative adjustment. In order to register point clouds from different scan positions, the ICP algorithm is applied. Initial values for ICP are obtained automatically by using images acquired from adjacent scanning positions. For this, SIFT points on images of overlapping scans are extracted, matched and related to the scans to provide 3D point corres- pondences, which allow the required approximate 3D registration. The tools employed here for surface smoothing are also presented. Finally, examples are given to illustrate the performance of described methods.

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