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ANALYSIS OF TWO TRIANGLE-BASED MULTI-SURFACE REGISTRATION ALGORITHMS OF IRREGULAR POINT CLOUDS

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Abstract. The registration of multiple surface point clouds into a common reference frame is a well addressed topic, and the Iterative Closest Point (ICP) is – perhaps – the most used method when registering laser scans due to their irregular nature. In this paper, we examine the proposed Iterative Closest Projected Point (ICPP) algorithm for the simultaneous registration of multiple point clouds. First, a point to triangular patch (i.e. closest three points) match is established by checking if the point falls within the triangular dipyramid, which has the three triangular patch points as a base and a user-chosen normal distance as the height to establish the two peaks. Then, the point is projected onto the patch surface, and its projection is then used as a match for the original point. It is also shown through empirical experimentation that the Delaunay triangles are not a requirement for establishing matches. In fact, Delaunay triangles in some scenarios may force blunders into the final solution, while using the closest three points leads to avoiding some undesired erroneous points. In addition, we review the algorithm by which the ICPP is inspired, namely, the Iterative Closest Patch (ICPatch); where conjugate point-patch pairs are extracted in the overlapping surface areas, and the transformation parameters between all neighbouring surfaces are estimated in a pairwise manner. Then, using the conjugate point-patch pairs, and applying the transformation parameters from the pairwise registration as initial approximations, the final surface transformation parameters are solved for simultaneously. Finally, we evaluate the assumptions made and examine the performance of the new algorithm against the ICPatch.

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