Planar Patch Detection In Disparity Maps

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Finding a vectorized digital elevation models (VDEM) of a urban scene is of great interest. It is necessary for various applications such as urban planning, radiowave reachability, disaster recovery, etc. This paper concentrates on a crucial step in the obtention of VDEMs, namely the optimal grouping of 3D point clouds representing the underlying surface, into planar patches, whenever possible.

Even though the input 3D point clouds may come from a variety of sources (including LIDAR, SAR interferometry, or other range scanning techniques), and despite the potential applicability of our technique in those settings, we concentrate here in the specific case of disparity maps obtained by photogrammetry from low-baseline stereo pairs [1]. Such 3D measurement systems have a certain number of advantages (sure and independent punctual matches become feasible in a relatively dense area [2]), but they also introduce new challenges, since fattening artifacts become specially important, and highly subpixel-accurate disparities are required to obtain a usable accuracy in height. For this reason careful regularization techniques (like the robust affine regression we propose here) are crucial to obtaining the required accuracy level.

Various methods were previously proposed to find a 3D model from a disparity map. In [3] the authors used a dictionary of complex building models to fit the disparity map. However the applicability to the low-baseline case is less evident because the initial delimitation of buildings by rectangle-fitting to the disparity map is more error prone when the latter is noisy and affected by fattening (adhesion) artifacts. In addition the slow convergence of the underlying non-convex optimization procedure, may scale up when the number of models in the dictionary is increased to more closely fit reality. In [4], the authors tried to match line segments of both images in order to find the height of a 3 dimensional edge. They then tried to match each half plane on both sides of the segment to find the vectorization of the scene. Despite their good results in urban areas, their method does not apply to low baseline stereo, because it relies on segment-to-segment matching, which proved to be not precise enough in this case [2]. In [5], the authors propose an a contrario region merging procedure to obtain a piecewise affine disparity map. However, the procedure is highly dependent on the initial partition. This initialisation is obtained by assuming that quasi-uniform gray-levels imply a common affine model, which is often, but not always the case, even under Lambertian hypotheses.

The aim of our work is to develop an automated method to obtain a piecewise planar description of a 3D point cloud, which avoids to resort to complex models as in [3], and also by basing decisions mostly on 3D information, rather than on error-prone luminance-based heuristics like in [5]. These characteristics should make it better-suited for the low-baseline stereo case.

Références