Recognition of Wall Surfaces from Monocular Imagery for SLAM Applications in Indoor Environments

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Abstract—Recognition of wall surfaces and other structural line segment features is an important aspect of LASER based Simultaneous Location and Mapping (SLAM) applications. Traditional indoor structural environment modeling algorithms employ schemes such as clustering of point clouds for parameterization and identification of the wall surfaces that serve as features to localize and map the environment of interest. RANSAC based line fitting and Spike detection are two common approaches in this regard. Alternatively, extensions to feature based stereo have also been used, mainly focusing on 3D line descriptions, along with techniques such as half-plane detection, real-plane or facade reconstruction, plane sweeping etc. Noise in the range data (from either LASER or stereo), especially in low texture regions, accidental line/plane grouping under lack of cues for visibility tests, presence of depth edges or discontinuities that are not visible in the 2D image and difficulties in adaptively estimating metrics for clustering can hamper efficiency of practical systems. In order to counter these issues, we propose a novel framework to use monocular imagery of the scene fusing 2D local and global features such as edges, texture and regions to detect wall surfaces and then use the resulting wall segmentation masks to guide the range data clustering. The focus of this paper is on the novel wall surfaces detection algorithm. Accuracy of recognition of wall surfaces is estimated with respect to a number of different material surface types, found in typical indoor environments. Testing on a representative dataset yielded recognition rates in excess of 95%, at 97% wall detection accuracy.