

Good Line Cutting: towards Accurate Pose Tracking of Line-assisted VO/VSLAM

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Abstract. This paper tackles a problem in line-assisted VO/VSLAM: accurately solving the least squares pose optimization with unreliable 3D line input. The solution we present is *good line cutting*, which extracts the most-informative sub-segment from each 3D line for use within the pose optimization formulation. By studying the impact of line cutting towards the information gain of pose estimation in line-based least squares problem, we demonstrate the applicability of improving pose estimation accuracy with good line cutting. To that end, we describe an efficient algorithm that approximately approaches the joint optimization problem of good line cutting. The proposed algorithm is integrated into a state-of-the-art line-assisted VSLAM system. When evaluated in two target scenarios of line-assisted VO/VSLAM, low-texture and motion blur, the accuracy of pose tracking is improved, while the robustness is preserved.

Keywords: SLAM, line feature, least squares

1 Introduction

Visual Odometry (VO) and Visual SLAM (VSLAM) methods typically exploit point features as they are the simplest to describe and manage. A sensible alternative or addition is to consider lines given that edges are also fairly abundant in images; especially within man-made environments where sometimes the quantity of points may be lacking to the detriment of VO/VSLAM. The canonical examples being corridors and hallways, whose low-texture degrades the performance of point features methods. Under these circumstances, lines become more reliable constraints versus points.

Compared to points, additional benefits of lines is that their detection is less sensitive to the noise associated to video capturing, and that lines are trivially stable under a wide range of viewing angles [1, 2]. Additionally, lines are more robust to motion blur [3]. Even with heavily blurred input image, one would expect some lines that are parallel to the local direction of blur to remain trackable. That said, lines don't provide as strong a motion constraint as points, so incorporating whatever points exist within the scene is usually a good idea.

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