Segmentation based Stereo Matching Using Color Grouping

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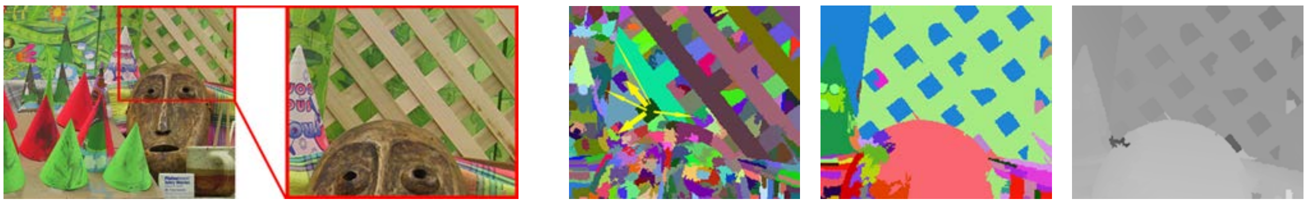

(a) (b) (c) (d)

Figure 1: *The result on case "cones". We amplify the region which contains the fragmented background in (a). (b) The visualization of the proximity constraint. We use color histogram matching to further group initialized segments. Those segments in a same color group are connected by arrows. A stronger arrow denotes higher proximity penalty which depends on the segment distance and area. (c) The visualization of final object labeling. After plane assignment by considering proximity constraint, almost all fragment background regions are connected. (d) The disparity reconstruction.*

1 Introduction

Segment-based methods become significant researches since they produce better result on the standard dataset [Scharstein and Szeliski 2002]. The kernel spirit is that all pixels in the same segment are regularized by a 3D geometric plane or a surface spline. This strategy better discriminates region discontinuities and achieves intra-object smoothing. However, few methods explicitly handle 2D-fragmented regions which are actually connected in 3D space. Such case often happens on the background occluded by several objects. To our knowledge, only object stereo [Bleyer et al. 2011] propose a 3D connectivity term in their optimization framework. Different from their method, our idea is to use proximity constraint based on color cues to evaluate the scene geometry. The proximity is widespread in real scenes and is recognized by human perception system - separate segments with similar colors usually come from the same object in real world. We propose a segment-based proximity formulation into the energy minimization framework. Figure 1 shows the proximity idea, the recovered segment connectivity, and the disparity reconstruction in case "cones" of the Middlebury dataset [Scharstein and Szeliski 2002].

2 Energy Formulation

The proposed energy consists of four terms.

$$E = E_{data} + E_{smooth} + E_{occlusion} + E_{proximity} \quad (1)$$

The terms E_{data} and E_{smooth} are to evaluate the matching cost of non-occluded pixels and segment boundary smoothness. Occluded pixels are additionally assigned a constant penalty in $E_{occlusion}$, or many regions tend to be occluded. Now we introduce the proximity constraint for segments.

$$E_{proximity} = \sum_{(Si,Sj)\in C, O(Si)\neq O(Sj)} \lambda_p \rho_d(Si, Sj) A(Sj) \quad (2)$$

, where λ_p is a weighting parameter, C denotes the set that a pair of segments (Si, Sj) is in a same color group, i.e., *possible* in a same object, and O are object labels of segments. $O(Si)$ will equal $O(Sj)$ once they are assigned closed 3D planes. $\rho_d(\cdot)$ is a distance function normalizes the difference of center position of Si and Sj, and $A(\cdot)$ normalizes the area of Sj. The proximity constraint tends to give a same 3D plane once a pair of segments is close and their area is large.

3 Future Work

So far we use color cues to group segments, and other appearance models should be considered. Furthermore, we plan to combine the proximity constraint and local smoothness into a unified scene smoothness model. We believe that the proposed idea will also contribute to the scene segmentation for complex foreground and background configuration, especially in outdoor scenes.

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References

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