Edge Preserving Stereo Matching Using Modified Distance Transform

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SUMMARY

Edge preservation is a difficult issue in computer vision. Specifically, in regards to stereo matching, distance transform (DT) is capable of improving edge regions in the disparity map. In this paper, we propose a modified distance transform (MDT) for enhanced edge preservation.

I. INTRODUCTION

Depth information is vital in 3D content generation. This can be acquired by stereo matching. In general, edge regions differentiate objects from the background. Thus, accurate disparity estimation is crucial especially in edge regions. Distance transform is an edge preserving transform and this transform is calculated iteratively [1]. In this paper, we modify this technique, removing iterative computation.

II. PROPOSED METHOD

Edge detection is performed prior to applying a 3 x 3 sized kernel. If edges exist within the kernel, block distance from every pixel to the edge pixel is calculated using Eq. (1). *x* and *y* denote pixel coordinates; *s* and *t* represent edge positions within the kernel; dt_t is the distance transformed value.

$$dt_t(x,y) = (|x-s| + |y-t|) \cdot 10 \tag{1}$$

$$f(dt_t) = 1 - e^{-\frac{dt_t^2}{2\sigma_f}},\ g(|I_{L,s} - I_{L,t}|) = e^{-\frac{|I_{L,s}-I_{L,t}|^2}{2\sigma_g}} \tag{2}$$

In Eq. (2), dt_t is the MDT map value at *t*, the neighboring pixel of center pixel *s* in the window; I_L represents the luminance in the left image. The data term of energy function is computed by Eq. (3).

$W_{s,t}(dt_t)$ is the multiple of two weight functions in Eq. (2). $F_{s,t}(d_s)$ represents the absolute difference of the kernel luminance between stereo images. We apply the sum of absolute differences (SAD) cost in non-transformed regions and optimize the energy function using hierarchical belief propagation (HBP) [2].

$$D_s(d_s) = \frac{\sum_{t \in N(s)} W_{s,t}(dt_t) \cdot F_{s,t}(d_s)}{\sum_{t \in N(s)} W_{s,t}(dt_t)} \tag{3}$$

III. EXPERIMENT RESULTS

We conducted experiments to evaluate the performance of MDT and compare it to conventional DT. We used bad pixel rate (BPR) in the performance evaluation.

Table 1: Performance Comparison

	HBP-DT		Proposed	
	BPR_all	BPR_disc.	BPR_all	BPR_disc.
Teddy	16.93	22.76	16.86	22.20
Cones	15.78	16.47	15.66	16.57
Tsukuba	3.99	10.32	4.08	10.71
Venus	2.90	16.16	2.86	14.95
Average	9.90	16.43	9.87	16.11

IV. CONCLUSION

In this paper, we presented an MDT algorithm which targets preservation of edge regions in the disparity map. As a result, the proposed method achieved 0.32% error reduction in discontinuous regions when compared to DT algorithm.

V. ACKNOWLEDGEMENT

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