2nd EEECS 2016

Academic Exchange Center,
Ocean University of China, Yushan Campus

Qingdao, China
August 10-13, 2016

Qingdao classic

Friendly Shandong 山東 文化圣地 度假天堂

Academic Exchange Center, Ocean University of China, Yushan Campus

August 10-13, 2016 Qingdao, China

2nd EEECS 2016 & 3D VR Contents

2016 IASER International Conference

2nd International Conference on Electronics, Electrical Engineering, Computer Science : Innovation and Convergence

CONFERENCE PROGRAM

IASER International Association of Science & Engineering Researcher

KOCTA Korea Culture&Contents Technology Association 한국문화콘텐츠기술학회

3D 3차원 방송영상학회 3D BROADCASTING AND IMAGING ASSOCIATION

CONFERENCE PROGRAMME

Venue: Hongkong, Macao, Haida, Sunchine
Ocean University of China, Academic Exchange Center

Wednesday 10th August 2016

16:00-18:00 **REGISTRATION OF DELEGATES (1F Lobby)**
Arrival and Distribution of Conference Information

IASER Executive Board Meeting

IASER Steering Committee members only

19:30-21:00 **WELCOME RECEPTION**
Sunshine Hall

Thursday 11th August 2016

09:00-12:30 **REGISTRATION OF DELEGATES**
Arrival and Distribution of Conference Information

09:00-10:20 **SESSION 1 Oral Presentation**
Hongkong Hall

Chair: Kyoungro Yoon (Konkuk Univ.), Yiying Zhang (Tianjin Univ. of Science and Technology)

02EEECS169

Motion Recognition and Spinal Monitoring Based on Hidden Markov Models and K-means Clustering Using Wearable Sensors

Juan Wu, QuanZhe Li, Shin-Dug Kim' (Yonsei University, Korea) Cheong-Ghil Kim (Namseoul University, Korea)

02EEECS155

Direction finding based on cuckoo search algorithm in the strong impulse noise

Jia Li, Yansong Liang, Hongyuan Gao, Ming Diao (Harbin Engineering University,China)

02EEECS187

A Disparity Search Range Estimation Method Using Cluster Blocks

Taewoong Ahn, Byungin Moon (Kyungpook National University, Korea)

02EEECS225

Adaptive Scientific Visualization of Color Information in Image

Takaaki Ishikawa (Waseda University, Japan),Yong-Hwan Lee (Far East University, Korea) Youngseop Kim (Dankook University , Korea)

09:00-10:20 **SESSION 2 Oral Presentation**

Macao

Chair: Qian Zhang (Taishan Univ.), Sang-Kyun Kim (Myongji Univ.)

02EEECS189

3D Audio Down-Mixing System for Immersive Realistic Virtual Reality

Dukki Hong, Seiyoung Lee, Woo-Chan Park (Sejong University, Korea)

02EEECS138

Relay selection scheme based on quantum differential evolutionary algorithm in relay networks

Hongyuan Gao , Shibo Zhang , Ming Diao, Yanan Du (Harbin Engineering University, China)

02EEECS142

Dynamic QoS-based video transmission in Wireless Information-Centric Networks

Longzhe Han, Jia Zhao, Xuecai Bao, Li Lv, Wei Tian (NIT , China)

02EEECS115

A Compact Micro-strip λ/4-SIR Dual-Band Band-pass Filter Design

Chang Soon Kim, Tae Hyeon Lee, Kwang Seob Shin , Bhanu Shrestha , Kwang Chul Son (Kwangwoon University,Korea)

09:00-10:20 **SESSION 3 Post Presentation**

Foyer

Chair: Youngseup Kim (Dankook University), Dongsoong Han (Jeongju University)

02EEECS116

New SSD structuere for low power and high performance

Bo Sung Jung, Jung Hoon Lee (Gyeongsang National University,Korea))

A Disparity Search Range Estimation Method Using Cluster Blocks

Taewoong Ahn and Byungin Moon*
School of Electronics Engineering
Kyungpook National University
Daegu, Korea
myannet@ee.knu.ac.kr, bihmoon@knu.ac.kr

***Abstract*—This paper proposes a disparity search range (DSR) estimation method for stereo matching. For the DSR estimation of the current frame, the proposed method uses cluster blocks made from the depth map of the previous frame in consecutive stereo frames. The method splits an input depth map into several base blocks, and then analyzes them to find which of them have similar disparities. A group of base blocks which have similar disparities forms a cluster block. The method performs DSR estimation separately within each cluster block, and the estimation results are used for disparity calculation of the next frame. The simulation results show that, when compared with the conventional methods, the proposed one has smaller DSRs, which result in reduction of matching operations, while maintaining higher or similar matching accuracy.**

Keywords—stereo matching; disparity; disparity search range; disparity search range estimation; cluster block;

I. INTRODUCTION

Stereo matching is an active research area in computer vision. It extracts 3D distance information of objects from two images which are captured by stereo camera. The 3D distance information is used in broad areas, such as robot visions, autonomous vehicles, etc. These areas need consecutive 3D distance information in real time, so a stereo vision system needs not only a high matching accuracy but also low overhead of matching operations. To reduce the overhead of the stereo matching, disparity search range (DSR) estimation has been studied by many researchers because the DSR size is proportional to the overhead of matching operations [1-3].

Reference [1] proposed a DSR estimation method in consecutive frames. This method makes a disparity histogram of the depth map of the previous frame and estimates the DSR of the current frame by applying a threshold value to the histogram. The DSR estimation method using the threshold value is defined as

$$SR = \{n \mid n_{min} \le n \le n_{max}, h[n] > T_h\}, \quad (1)$$

where SR is a set of estimated disparities, n_{min} is the minimum value of the previous DSR, n_{max} is the maximum value of the previous DSR, $h[n]$ is the number of pixels which have a disparity value n, and T_h is a threshold value. Using (1), a disparity n is eliminated from SR, the estimated DSR when its frequency is less than or equal to T_h. This method erases low-frequent disparity noise, but when the DSR estimation is performed consecutively, the matching accuracy deteriorates because of successive shrinks of the DSR. To overcome this drawback, a DSR estimation method was proposed which applied a stretch function for widening the estimated DSR [2]. However, increasing the DSR size causes more calculations for stereo matching. To solve this problem, the method splits the whole image into blocks of the same size and estimates separately the DSR of each block [2]. This method reduces the matching overhead by reducing the DSR size, yet some blocks have still large DSRs even though they are smaller than the whole image. So, a DSR estimation method using multi-level blocking was proposed in [3] to remove blocks with large DSRs by splitting the whole depth map into blocks with various sizes. In this method, blocks are split iteratively into smaller blocks until the DSR size of the split block is smaller than a predetermined size or the number of splitting levels reaches a limitation. The method reduces matching overhead by splitting blocks with large DSRs into smaller blocks with small DSRs. However, it tends to cause too many noises because some disparity noises can be dominant in tiny blocks with small number of pixels and be included in the estimated DSR.

II. THE PROPOSED METHOD

This paper proposes a DSR estimation method using cluster blocks to reduce matching overhead. Fig. 1 is a flowchart of the proposed method, and Fig. 2 shows a process of making cluster blocks. The proposed method splits the whole depth map of the previous frame into small blocks called base blocks, as shown in Fig. 2(b). Then, the method makes disparity histograms of the base blocks and generates mask values $M_B[n]$ of each block, which are one or zero depending on whether n are included in interim estimated DSR, using (1) with T_B of (2) instead of T_h. In (2), T_B is the threshold value of each base block, H_B is a disparity histogram of each base block, α is a constant value, and β is a size ratio of a base block to the whole depth map. The method measures F_{pq}, dissimilarity between blocks p and q using (3), and then determines whether they are included in

This research was supported by the MSIP (Ministry of Science, ICT and Future Planning), Korea, under the ITRC (Information Technology Research Center) (IITP-2016-H8601-16-1002) supervised by the IITP (Institute for Information & communications Technology Promotion).

*Corresponding author: Byungin Moon

the same cluster block (C_{pq} = 1) or not (C_{pq} = 0) using (4), where T_C is a constant value used as a threshold. Fig 3(c) shows a result of clustering process. The cluster blocks have various sizes and shapes. Furthermore, base blocks located apart from each other can be included in the same cluster block. After making all cluster blocks, the method makes the interim DSR of each cluster block using (1) and (2). Finally, by applying the stretch function, it generates the DSR estimation results to be used in the depth extraction of the current frame.

$$T_B = \frac{max(H_B) \times \alpha}{\beta} \tag{2}$$

$$F_{pq} = \sum_{n=n_{min}}^{n_{max}} M_{B_p}[n] \oplus M_{B_q}[n] \tag{3}$$

$$C_{pq} = \begin{cases} 1, F_{pq} < T_C \\ 0, F_{pq} \geq T_C \end{cases} \tag{4}$$

III. Experiment and Result

We modeled the proposed and conventional methods by MATLAB R2014b. Fifty frames of both the tanks and tunnel images [4] were used for experiments, and the census transform was used to make a depth map. The DSR estimation method of [2] and the proposed method split the whole image into 4×4 blocks, T_C is set to 16 in the proposed method, and the maximum number of splitting levels is 3 in the DSR estimation method of [3]. To compare matching overheads of the proposed and conventional methods, millions of disparity evaluations (MDE) is calculated by (5), where W_i and H_i mean width and height of block i, respectively, and D_i is the number of disparities in block i.

$$MDE = \sum \frac{W_i \times H_i \times D_i}{10^6} \tag{5}$$

Table I shows experimental results. The proposed method has less MDE value than the conventional methods except the method of [1]. The method of [1] has the least MDE when it is used with the tunnel images because it reduces DSR size consecutively. However, this reduction of DSR size leads to the worst matching accuracy in the method of [1]. On the other hand, the other conventional methods and the proposed method have better matching accuracy than the method of [1] because they all apply the stretch function. Plus, Table I shows the proposed method has the least MDE compared with the methods of [2] and [3]. This means that, compared with the conventional methods of [2] and [3], the proposed method has the least operation overhead of stereo matching with higher or similar accuracy.

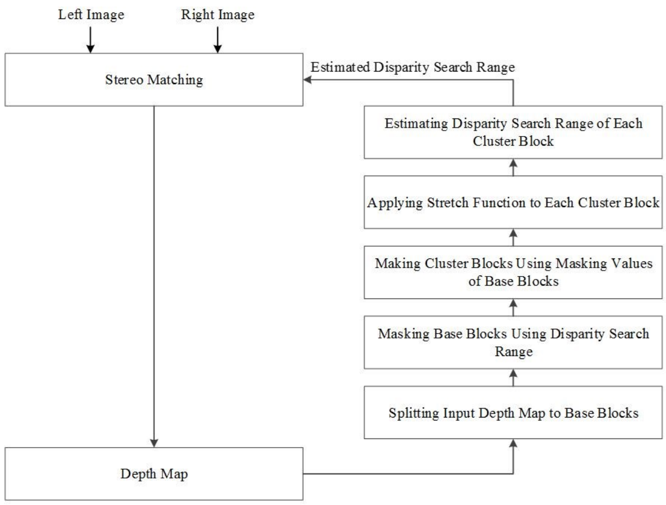
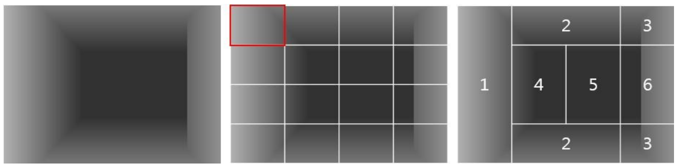


Fig. 1. Flowchart of the proposed method.



(a) Input depth map (b) 4 × 4 base blocks (c) Result of clustering

Fig. 2. The process of making cluster blocks.

TABEL I. Experimental Results

Parameter	Image	[1]	[2]	[3]	Proposed
Matching accuracy	Tanks	0.8101	0.8215	0.8218	0.8239
	Tunnel	0.6372	0.8463	0.8509	0.8496
MDE	Tanks	4.1569	4.1012	4.0199	3.8292
	Tunnel	2.1039	3.6075	3.5771	3.3197

IV. Conclusion

This paper proposed a DSR estimation method using cluster blocks to reduce matching overhead of stereo matching in consecutive frames. Experimental results show that the proposed method leads to similar or higher matching accuracy with less operation overhead of stereo matching when compared with conventional methods. However, this paper were simply focused on operation overhead of stereo matching, so future work will cover operation overhead of clustering process.

References

[1] H. C. Shin and K. H. Sohn, "Real-time depth range estimation and its application to mobile stereo camera," Consumer Communications and Networking Conference (CCNC), 2012 IEEE, pp. 5-9, January 2012.

[2] Seung-Ho Ok, "Modified Adaptive Support-Weight and Stretched Depth-Histogram Schemes for Stereo Matching Processors," Kyungpook National University, Thesis for the Degree of Ph. D., December 2013.

[3] Taewoong Ahn, Kyeong-ryeol Bae, and Byungin Moon, "Disparity Search Range Estimation Using Multi-level Block Partitioning of Disparity Images," The Proceedings of the 2015 KIIT Summer Conference, June 2015.

[4] C. Richardt, D. Orr, I. Davies, A. Criminisi, and N. Dodgson, "Real-Time Spatiotemporal Stereo Matching Using the Dual-Cross-Bilateral Grid," Computer Vision–ECCV 2010. Vol. 6313, pp. 510-523, November 2010.