Abstract

In this paper, we present an adaptive stereo matching for obtaining an accurate disparity map from an anaglyph image. Conventional adaptive stereo matching algorithms fail when addressing anaglyph images that do not have similar intensities on their two respective view images. To resolve this problem, we propose a novel data cost using local color. Experimental results confirm that the proposed data cost is robust and produces accurate depth maps.

II. Adaptive Data Cost using Local Color Prior

Conventional adaptive stereo matching forces similar intensity assumption to obtain an accurate disparity map. However, the nature of anaglyph image does not satisfy the assumption. Thus, we introduce a novel local color prior to estimate the missing color channel (i.e. to reconstruct pseudo color) so that it can make good use of the assumption. We exploit color transfer method to model the prior. The pseudo color of a patch is reconstructed by locally transferring the known color channel from the corresponding patch. For that reason, each patch has different pseudo color depending on the disparity candidate. The local color prior is the adaptive form of color transfer with weight \( w(p,q) \) between pixel \( p \) and \( q \).
Fig 1. Data cost curve comparison of a patch in Tsukuba data (red line denotes the ground truth).

Adaptive mean $\tilde{\mu}(p)$ and standard deviation
$\tilde{\sigma}(p)$ are computed as:

$$\tilde{\mu}(p) = \frac{\sum_{q \in N_p} w(p,q) I(q)}{\sum_{q \in N_p} w(p,q)}$$

$$\tilde{\sigma}(p) = \sqrt{\frac{\sum_{q \in N_p} w(p,q) \| I(q) - \tilde{\mu}(p) \|^2}{\sum_{q \in N_p} w(p,q)}}$$

where $I$ is the original intensity and $N_p$ is the local patch centered at $p$. Finally, the pseudo intensity $\tilde{I}$ is obtained by computing:

$$\tilde{I}(q) \leftarrow \frac{I(q) - \tilde{\mu}(p)}{\tilde{\sigma}(p)} + \tilde{\mu}(p')$$

where $s$ and $t$ denote the source and target color channels. Given pixel $p$ and label $f_p$, the corresponding pixel in another view is denoted by $p'$. For example, if we want to compute the pseudo intensity of left green channel $I_{g_l}$, we utilize the left red channel $I_{r_l}$ as the source and right green channel $I_{g_r}$ as the target patch ($s = \text{red}, t = \text{green}$).

The pseudo colors are utilized together with the original colors to measure the adaptive data cost. Adaptive data cost using local color prior is defined as follows:

$$e(q,q') = \min \{ |I_{q_l}(q) - \tilde{I}_{q_l}(p)|, |I_{q_r}(q) - \tilde{I}_{q_r}(p)|, \tilde{I}_{q_g}(q) - \tilde{I}_{q_g}(p) \}$$

$$D_p(I, \phi) = \frac{\sum_{q \in N_p} w(p,q) w(p',q') e(q,q')}{\sum_{q \in N_p} w(p,q) w(p',q')}$$

where $(r,l)$ and $(r,g,b)$ are the set of image positions (left and right) and color channels, consecutively. $e(q,q')$ is the pixel-based matching cost while $T$ is the truncation value of the cost. In summary, we estimate the missing color of a patch with the color information of corresponding patch. Thus, the color similarity is preserved for each channel.

Fig 2. Disparity maps of each data cost (Tsukuba data). (a) Result of proposed adaptive data cost; (b) Result of conventional adaptive data cost [1]:

Since we apply adaptive color transfer, minimum cost is obtained when the local structure is similar between corresponding patches. Fig 1 shows the data cost curve comparison of the corresponding patches in (304,97). It is shown that the proposed adaptive data cost obtains the correct disparity as its ground truth.

III. Experimental Results

To evaluate the robustness of the anaglyph stereo matching, we compare it with the conventional adaptive stereo matching algorithm. Fig 2 displays the disparity map comparison with the conventional adaptive stereo matching [1]. The proposed data cost achieves more pleasing result because the local color prior satisfies the intensity similarity assumption.

IV. Conclusion

In this paper, we proposed a novel adaptive stereo matching data cost for anaglyph image using local color prior. Local color prior was used to compute the pseudo color of missing color channels. It was shown that the proposed stereo matching outperformed the conventional approaches.

Acknowledgements

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIP) (No. NRF-2013R1A2A2A01069181).

참고문헌
