THE UNIVERSITY OF UTAH

Stereo using Rectified Images

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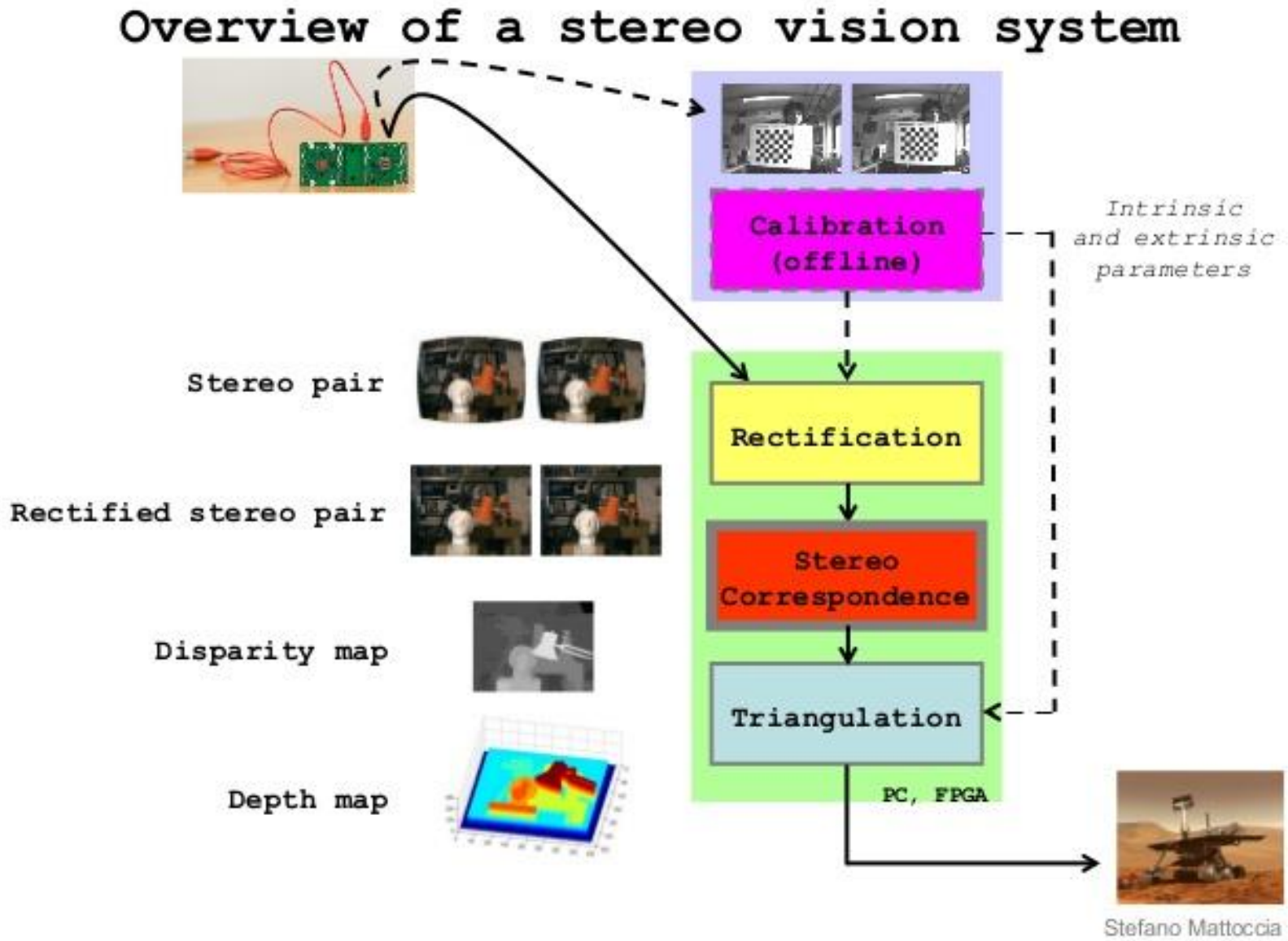
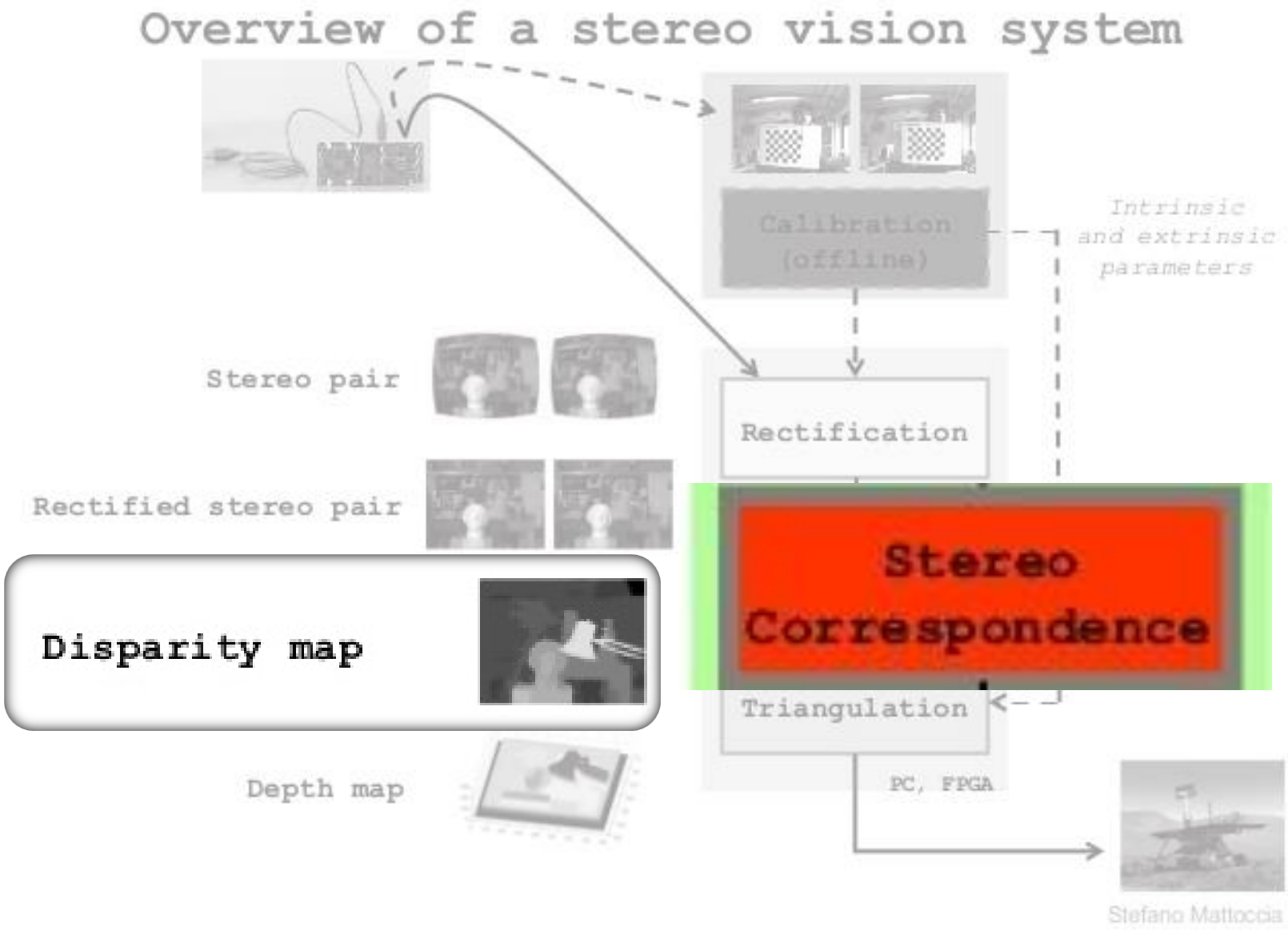
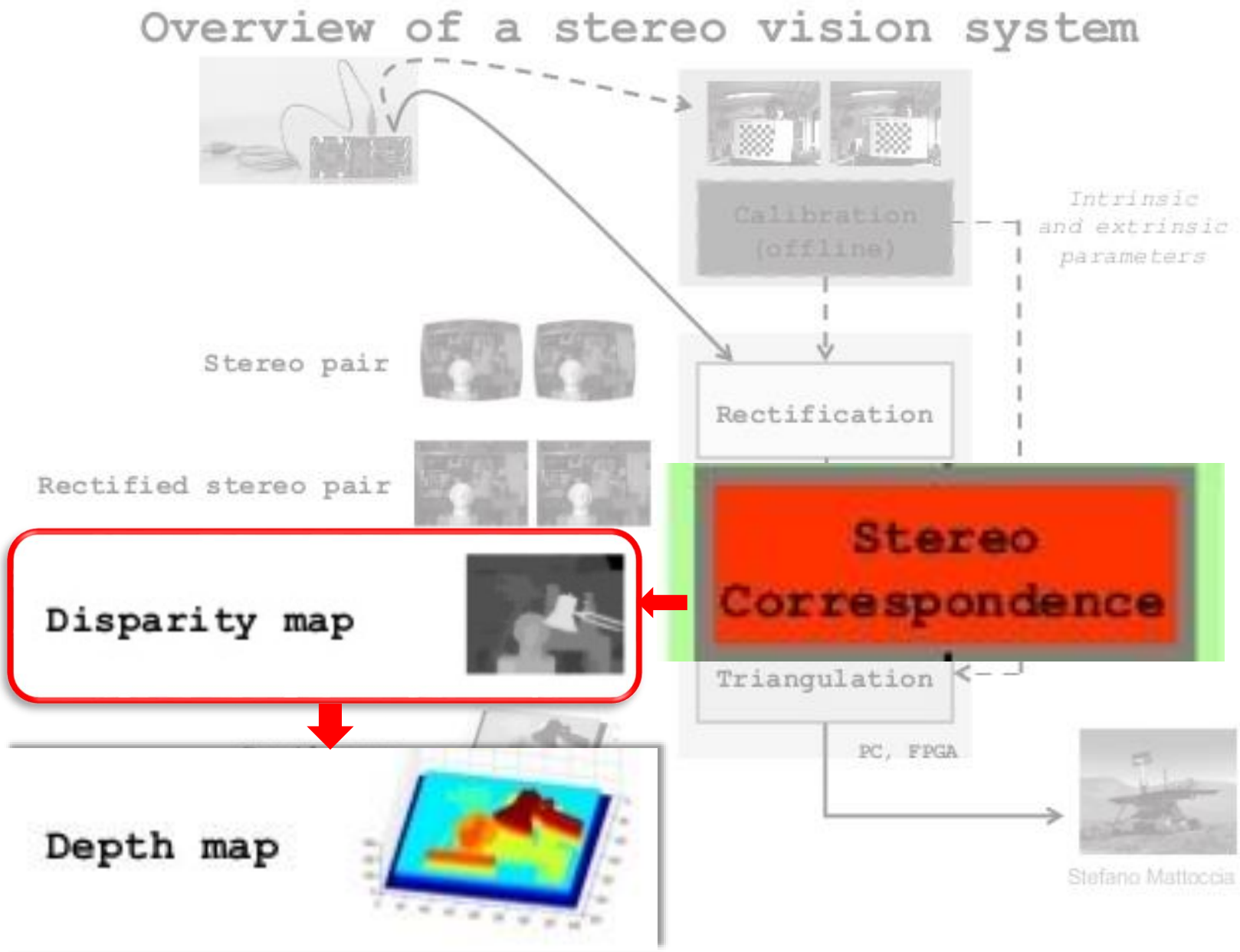
Bigger picture …



What we are doing …



What we are doing …



Project overview …

Goal

- Improve disparity map quality using image cues, intensity information.
- Improve brute-force search over every pixel by using faster techniques based on edge information.
- Handle occlusions.

Contributions

- Find good correspondences between two images.

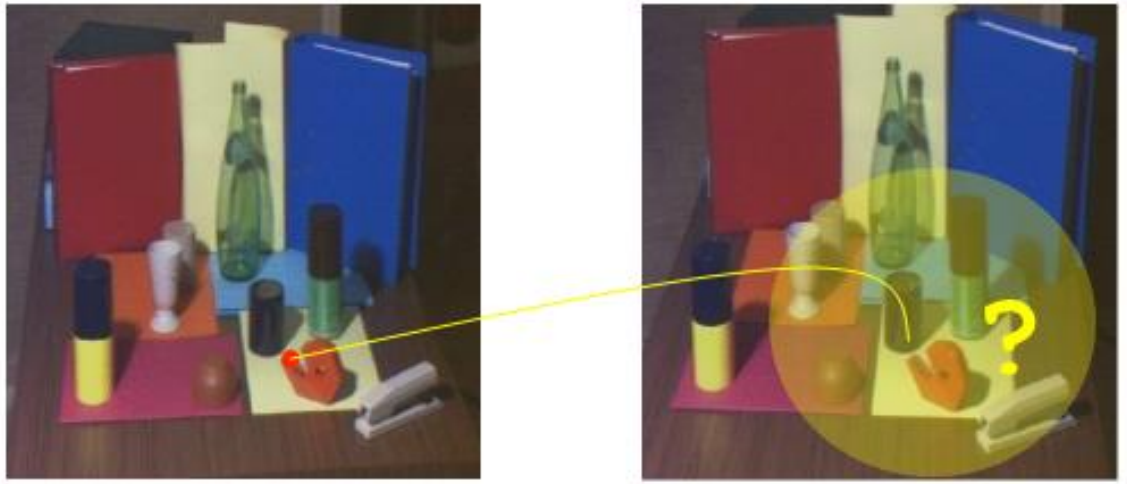
  Discuss algorithms !!
- Good disparity maps for depth reconstruction

  Image Processing for noise removal
- Evaluation

Good correspondence …

Brute Force

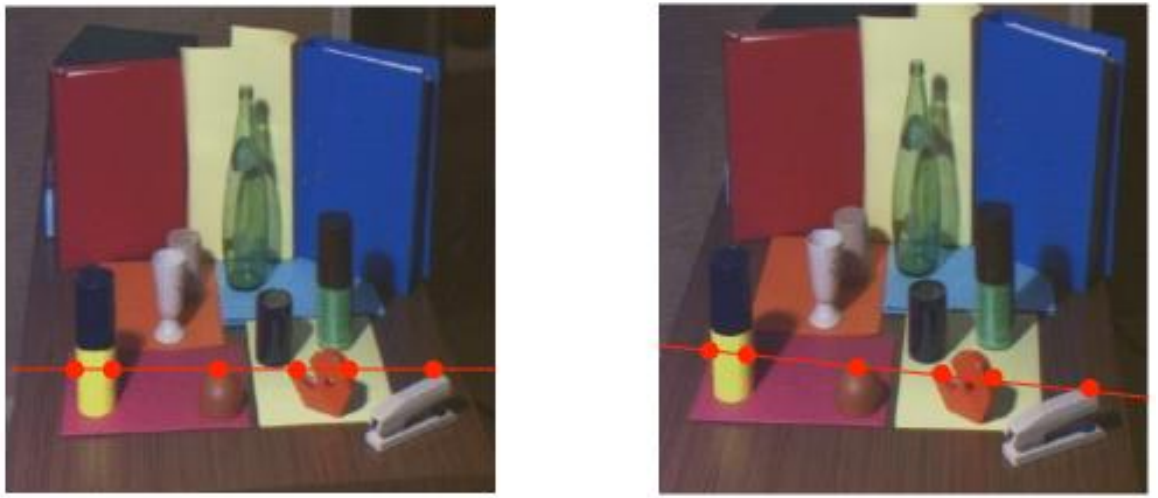
Input:



Reference (R) Target (T)

Search in patches around reference pixel for correspondence.

Output:



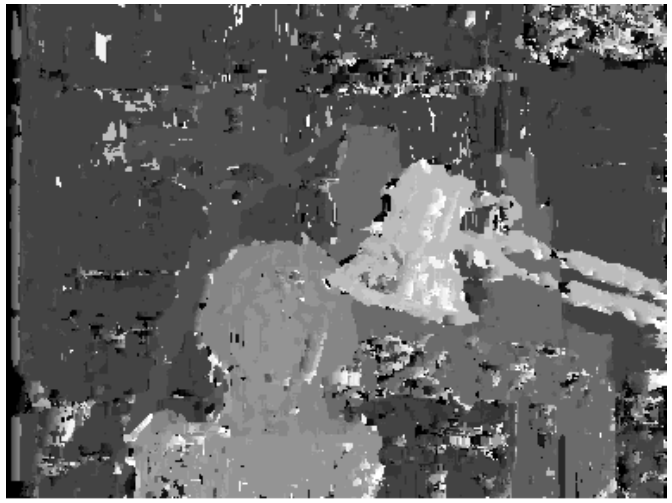
Reference (R) Target (T)

Cost(I_1,I_2) :
- squared difference
- normalized cross-correlation

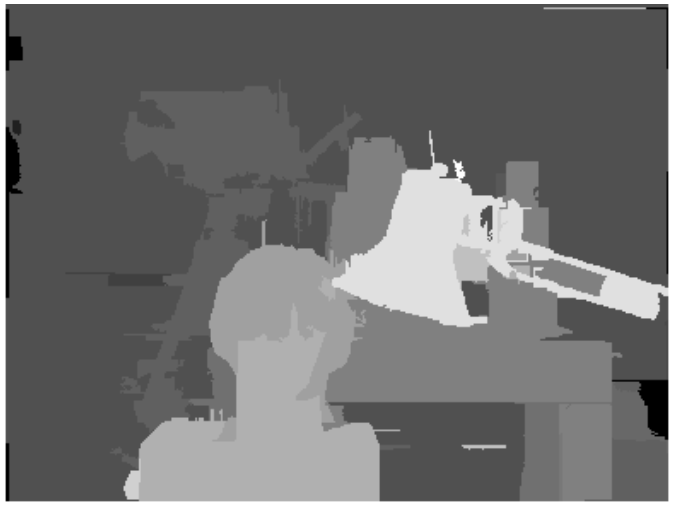
With Post-processing …

Mean Shift Segmentation[3] …

- For each i=1…n, compute the mean shift procedure for x_i and store convergence result in z_i
  (a) For pixel x_i, look around its neighbors and assign the same intensity of z_i to all the members.
- Identify clusters $\{C_p\}$, p = 1 … m of convergence points by linking together all z_i which are **close.**
- For i=1… n assign $L_i = \{ p \mid z_i \in C_p \}$
- For better output, eliminate spatial regions < M.



Disparity map : before smoothing



Disparity map : after smoothing

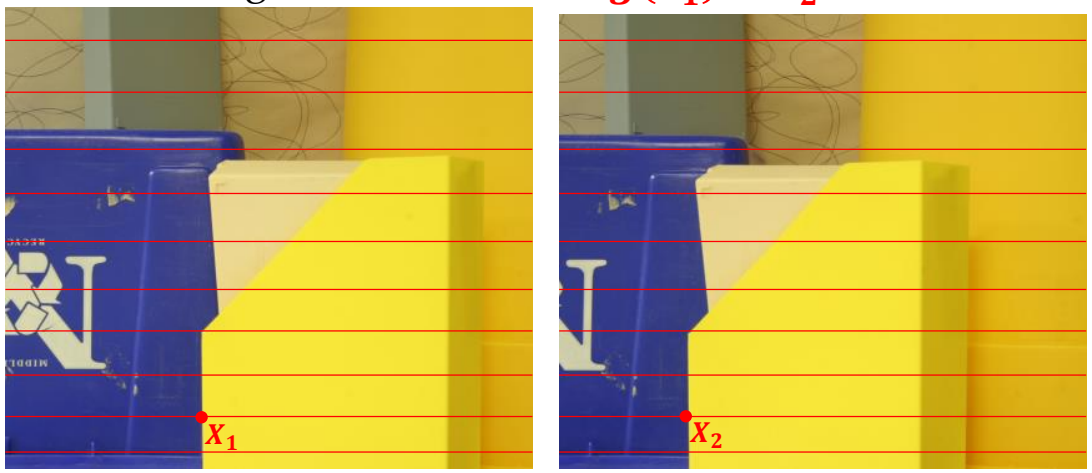
Input

Output

Good correspondence …

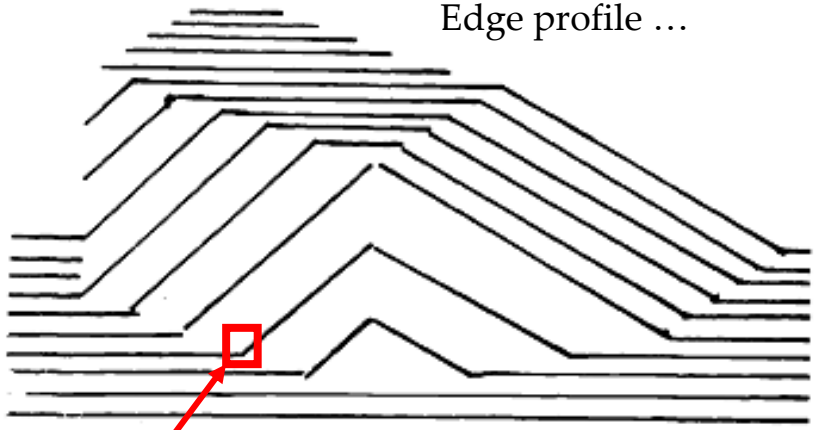
Stereo images …

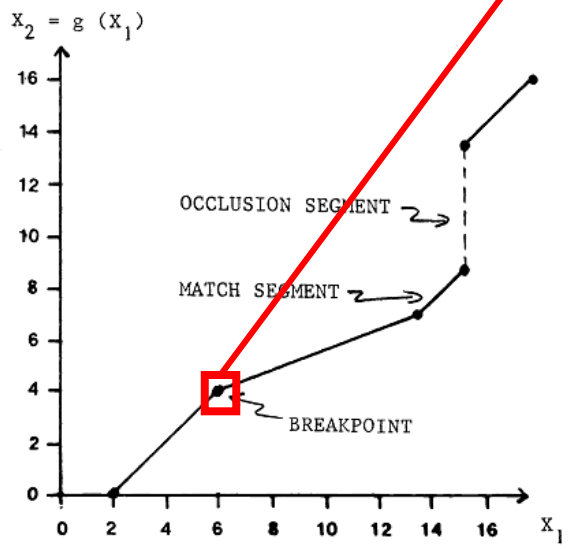
$g(x_1) = x_2$

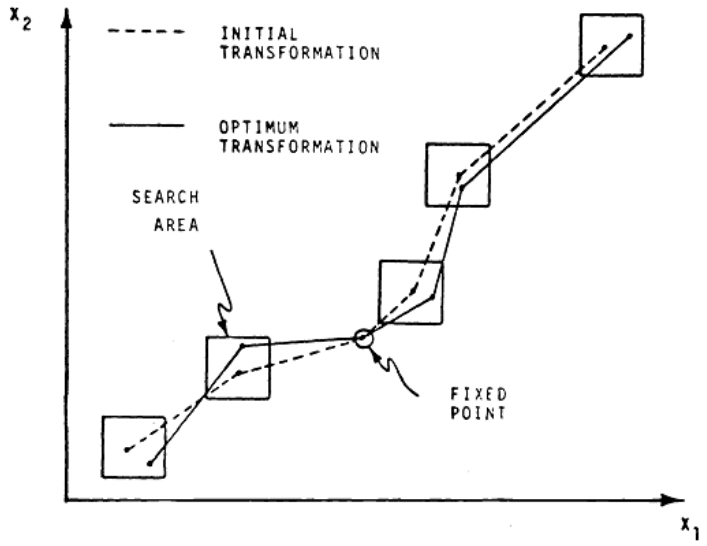


Sequential Matching of scan-lines(Miller et al. 1979)

Edge profile …





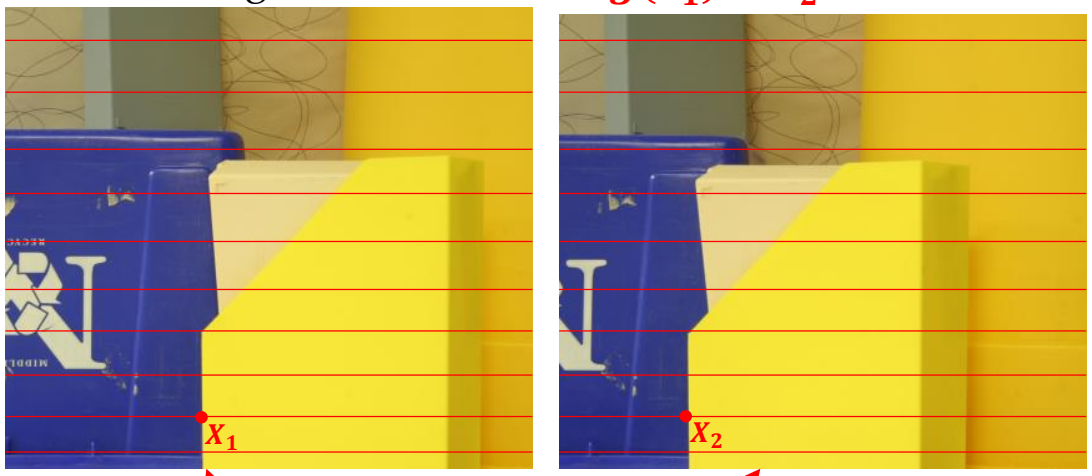


Broken segment matcher…

Good correspondence …

Stereo images …

$g(x_1) = x_2$



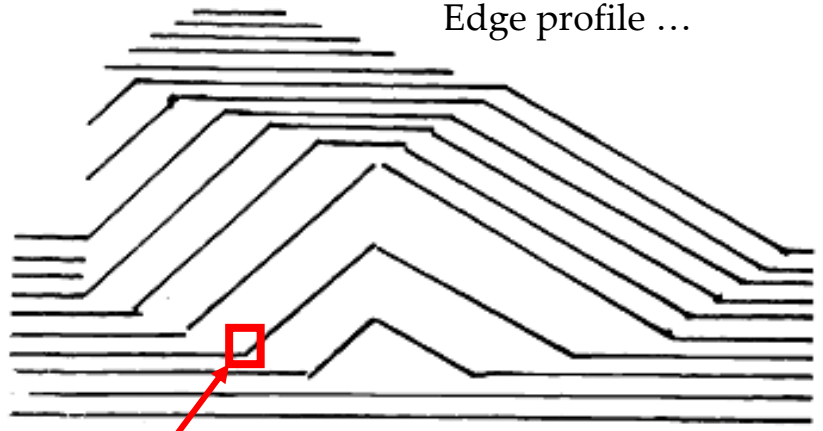
$$E(\lambda) = \int (I_1(x_1) - I_2(\, g(x_1;\lambda)\,)^2 dx_1 + \mathrm{reg}(\lambda)$$

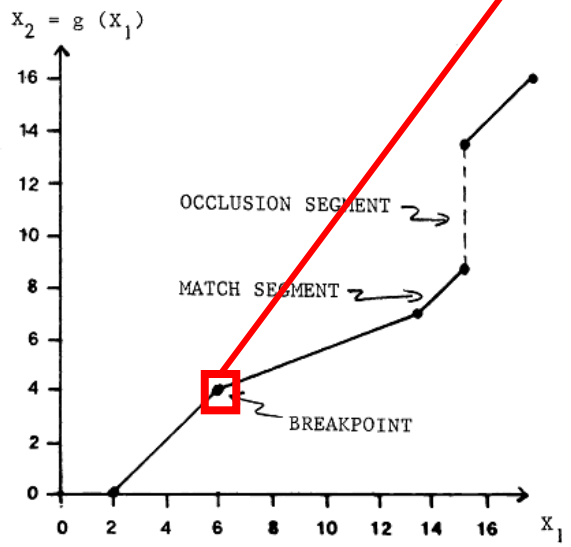
λ is the set of parameters describing the optimal transformation. Consider NO noise.

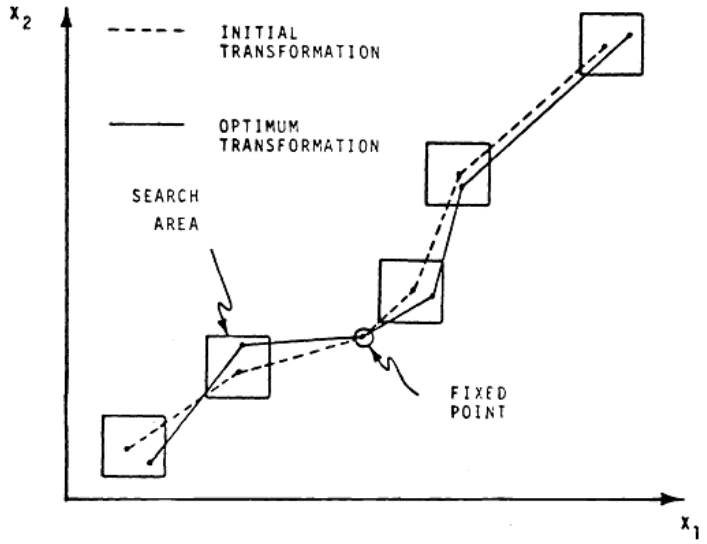
PRO: Separates occluded pixels(infeasible λ).

Sequential Matching of scan-lines(Miller et al. 1979)

Edge profile …



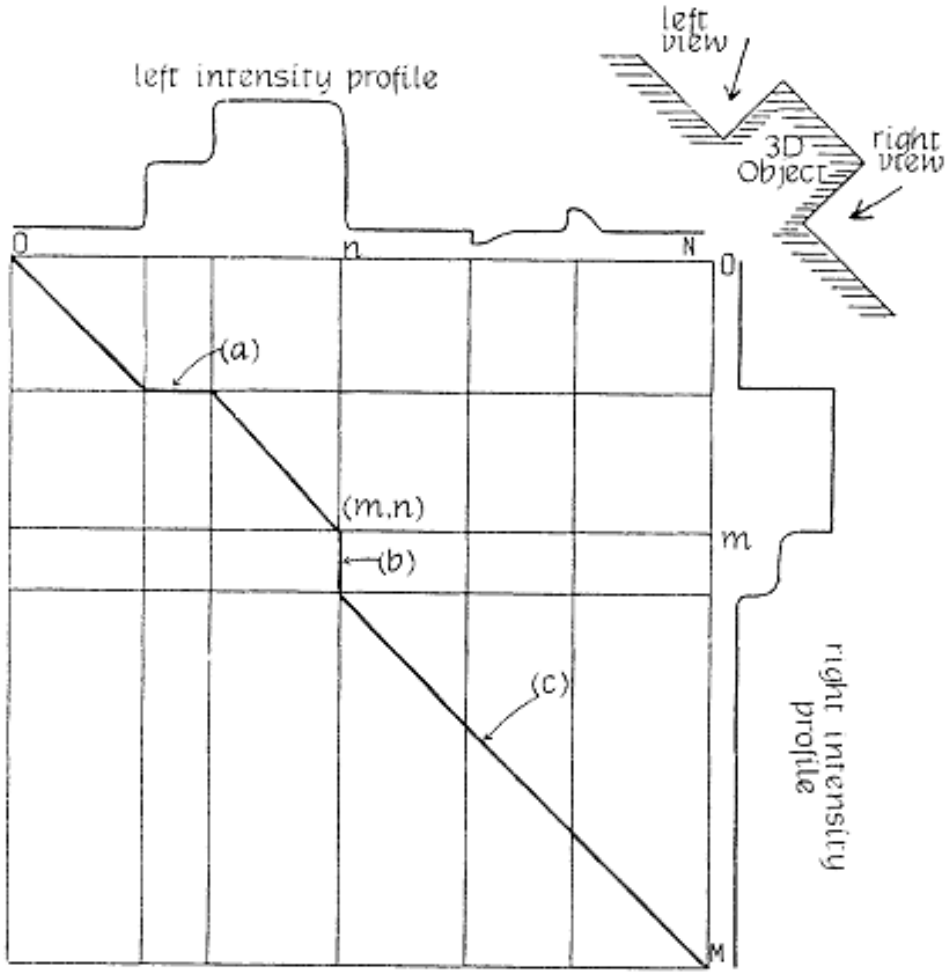




Broken segment matcher…

Good correspondence …

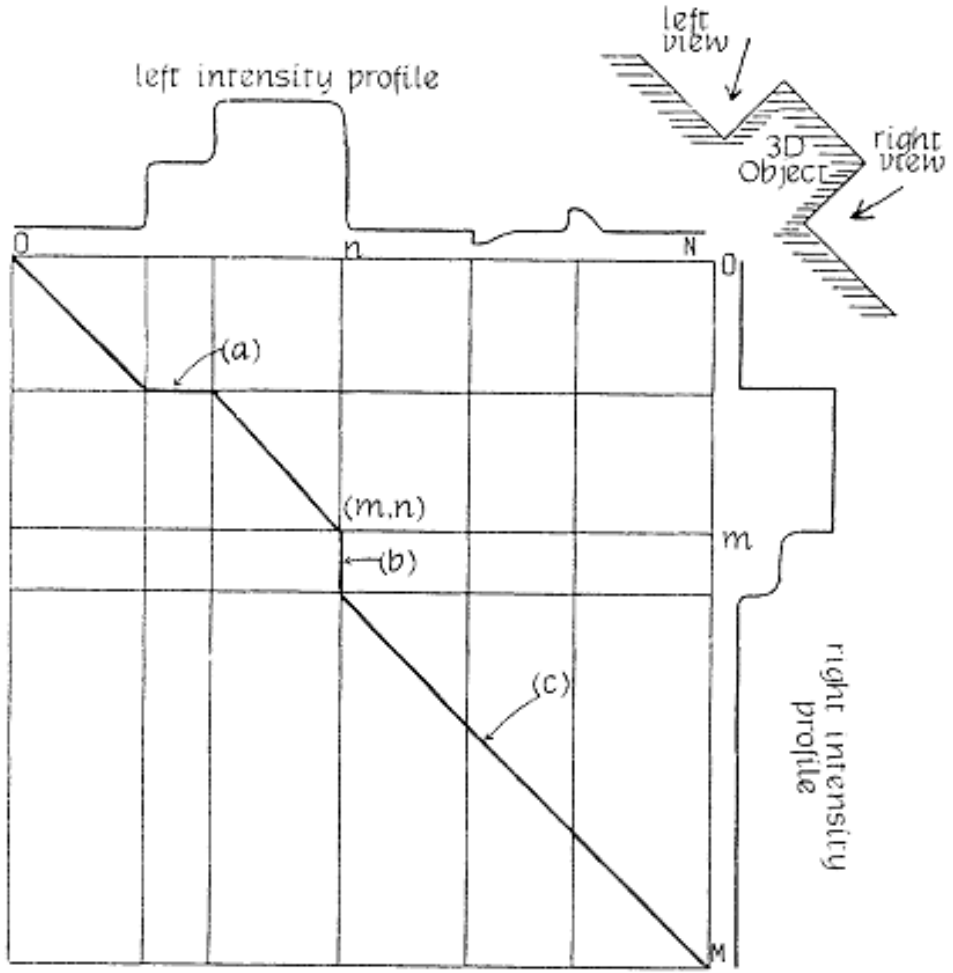
Dynamic Programming (Ohta & Kanade, 1985)



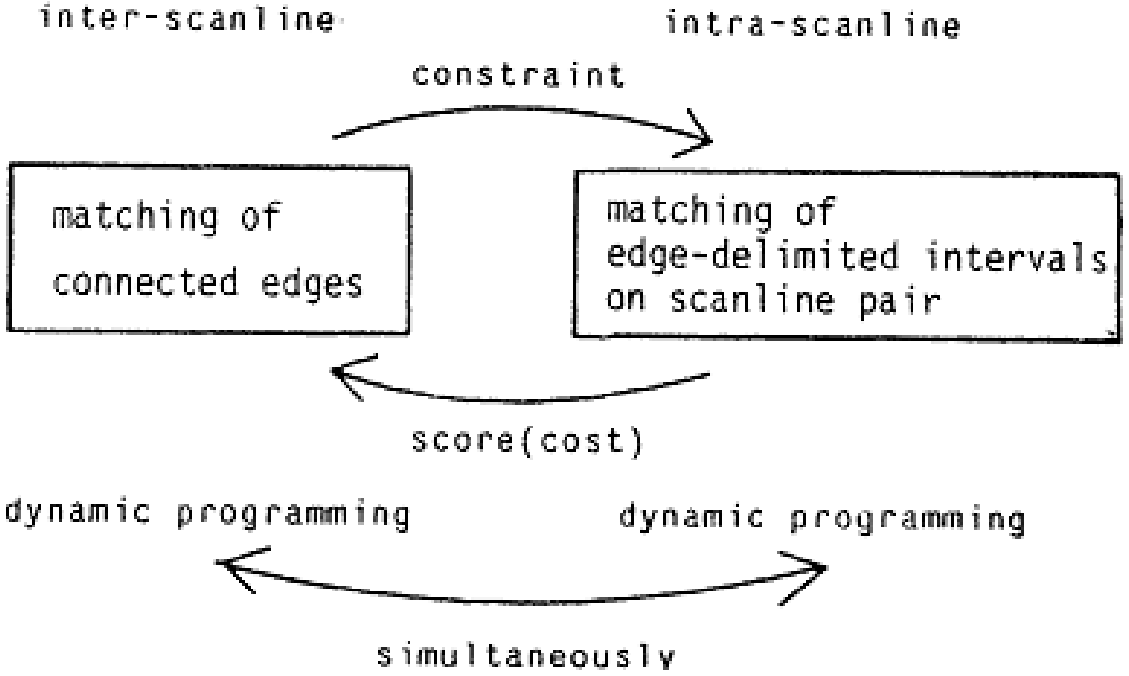
Intra-scanline search: Path finding using DP

Good correspondence …

Dynamic Programming (Ohta & Kanade, 1985)



Algorithmic overview



Intra-scanline search: Path finding using DP

Experimental Setup …

- Middlebury datasets(http://vision.middlebury.edu/stereo/data/)
- Ground-truth(GT) and camera calibration values provided.
- Images rectified using given parameters.
- Experiments evaluated for “tsukuba” and “bear” datasets.

```
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cam1=[3979.911 0 1369.115; 0 3979.911 1019.507; 0 0 1]
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baseline=193.001
width=2964
height=2000
ndisp=270
isint=0
vmin=23
vmax=245
dyavg=0
dymax=0
```
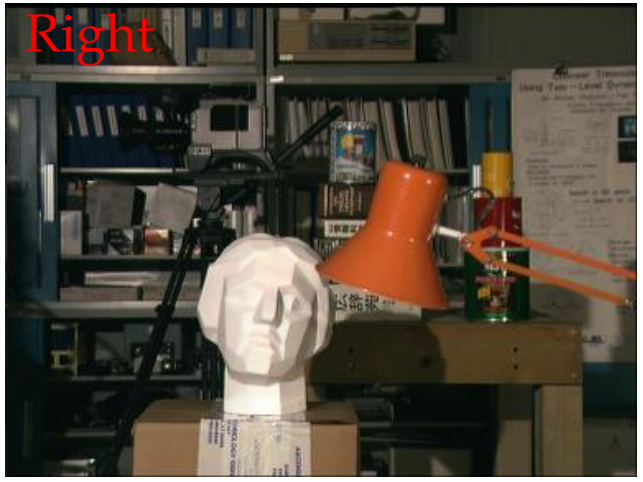
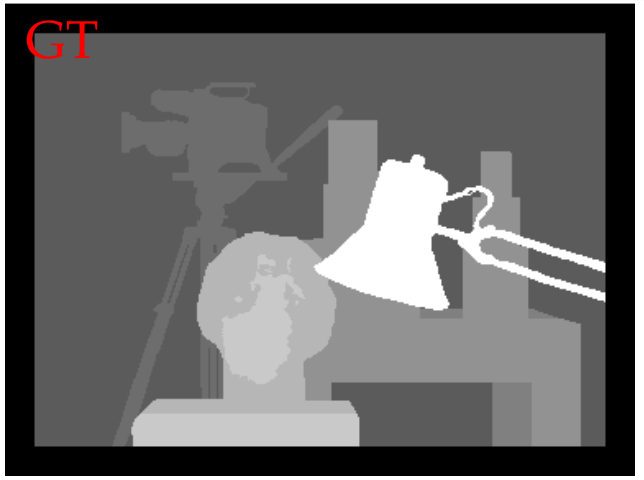
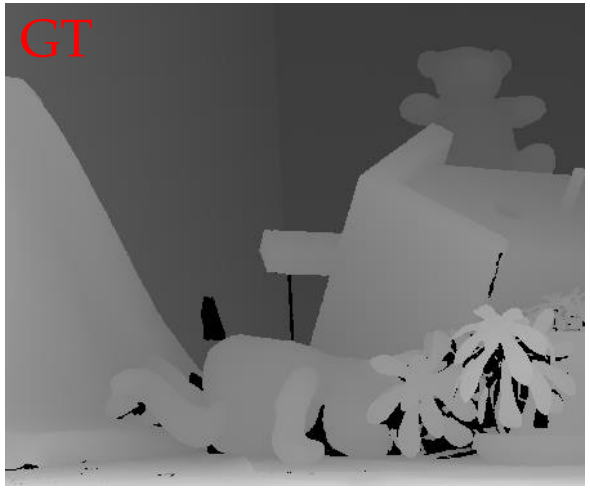

Calibration Matrix





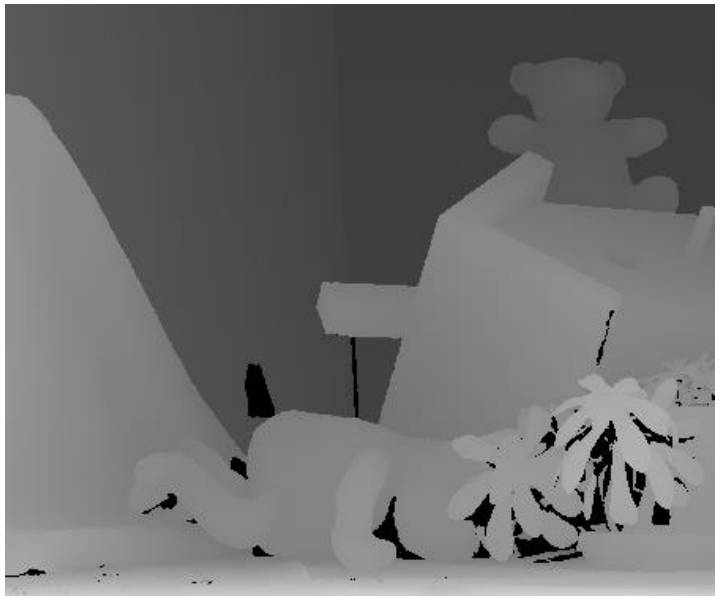


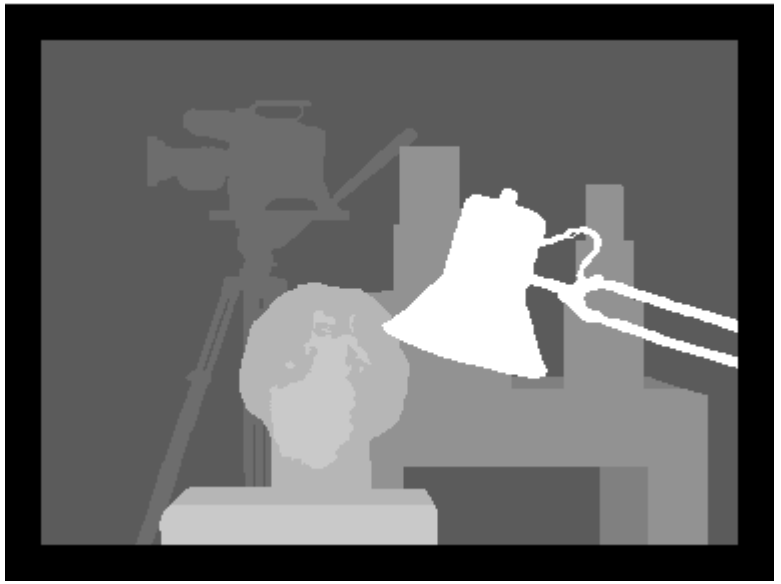
Evaluation …

Segmentation

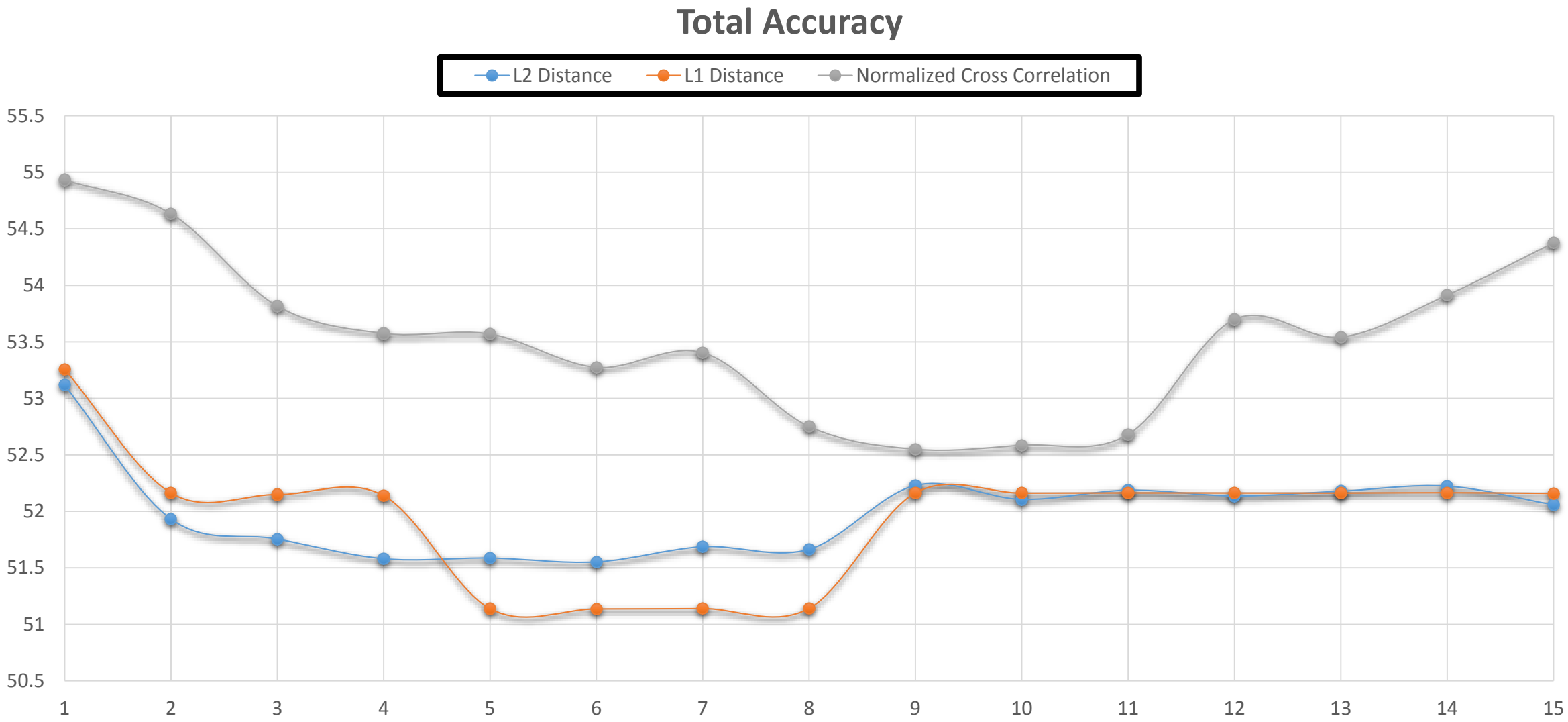
Ours

Ground-Truth





Effect of Window-sizes



References

[1] Hirschmuller, H., and Scharstein, D., "Evaluation of cost functions for stereo matching", In IEEE Conference on Computer Vision and Pattern Recognition (2007), pp. 1–8.

[2] Ohta, Y., and Kanade, T., "Stereo by intra- and inter- scanline search using dynamic programming", IEEE Transactions on Pattern Analysis and Machine Intelligence PAMI-7, 2 (1985), 139–154.

[3] http://luthuli.cs.uiuc.edu/~daf/courses/CS-498-DAF-PS/Segmentation.pdf

[4] Robert L. Henderson ; Walter J. Miller ; C. B. Grosch; "Automatic Stereo Reconstruction Of Man-Made Targets", Proc. SPIE 0186, Digital Processing of Aerial Images, 240 (September 4, 1979); doi:10.1117/12.957520.