Stereo matching

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Abbreviation: mrf-stereo
Number of instances: 3
Number of variables: a variable per pixel in the left image
Number of labels: 16, 20, or 60
Number of factors: a factor per pair of neighboring pixels in the left image (4-connectivity is assumed)
Order: 2
Function type: Potts, truncated linear, or truncated quadratic

Description In stereo matching a pair of left and right images is given as input and the goal is to find a disparity map (e.g., see Fig. 1) that specifies the value of the horizontal displacement for each pixel of the left image (in all our tests the left and right images are assumed to have been previously rectified, which means that only an horizontal displacement exists between corresponding pixels in the two input images).

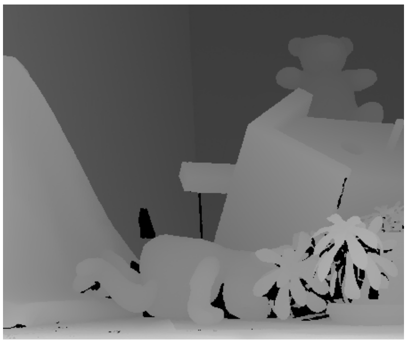

Figure 1: A ground truth disparity map for the 'Teddy' stereo pair from the Middlebury dataset.

Objective / Learning The above task can be formulated as an MRF optimization problem, where MRF nodes correspond to pixels of the left image and labels correspond to disparities. For the unary and pairwise potentials, we used the same settings as in [2]. More specifically, for the unary potentials the cost by Birchfield and Tomasi [1] has been used, which measures the absolute color differences between corresponding pixels and is also robust to image sampling. For the pairwise potentials we used the following smoothing costs $\varphi_{pq}(x_p, x_q)$:

- **'Tsukuba'**: $\varphi_{pq}(x_p, x_q) = w_{pq} \min(|x_p - x_q|, 2)$, where w_{pq} equals 2 if $\nabla_{pq} \leq 8$ and equals 1 otherwise.
- **'Venus'**: $\varphi_{pq}(x_p, x_q) = \min(|x_p - x_q|^2, 7)$.
- **'Teddy'**: $\varphi_{pq}(x_p, x_q) = w_{pq} \min(|x_p - x_q|, 1)$, where w_{pq} equals 3 if $\nabla_{pq} <= 10$ and equals 1 otherwise.

In the above, ∇_{pq} denotes the intensity gradient in the left image. No learning has been applied in this case.

References

[1] Stan Birchfield and Carlo Tomasi. A pixel dissimilarity measure that is insensitive to image sampling. *IEEE Trans. Pattern Anal. Mach. Intell.*, 20(4):401–406, 1998.

[2] Richard Szeliski, Ramin Zabih, Daniel Scharstein, Olga Veksler, Vladimir Kolmogorov, Aseem Agarwala, Marshall Tappen, and Carsten Rother. A comparative study of energy minimization methods for Markov random fields with smoothness-based priors. *IEEE PAMI*, 30(6):1068–1080, 2008.