On Cross-Spectral Stereo Matching using Dense Gradient Features

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**Issue:** Robust scene depth recovery from cross-spectral stereo imagery.

Each image sensing over a differing spectral range.

**Approach:** Dense unsigned gradient features in combination with a strong optimization approach.

Prior work either recovers depth from isolated scene objects (LSS features, [1]), uses simulated cross-spectral imagery (MI, [2]) or solely addresses radiometric differences in standard stereo image pairs (ZNCC, [3]).

Dense unsigned Histogram of Orientated Gradient (HOG) [4] outperform these feature matching approaches to produce coarse depth images suitable for scene understanding and reasoning.

With simple Winner Takes All (WTA) optimization unsigned HOG features yield unreliable depth results.

Unsigned HOG descriptors are efficiently computed [4] and L2 normalized. Pixel matching is then performed using L1 distance comparison.

Combined with Scan-line Optimization (SO), Dynamic Programming (DP), Graph Cuts (GC) or Semi-Global Matching (SGM) dense HOG features produce more stable, usable results.

Strong optimization approaches provide improved depth with DP and SGM providing usable results within reasonable computational bounds.

**Results**

Full scene depth recovery comparable in quality to that of standard optical stereo recovered from the same scene.

Unsigned HOG + SGM (bottom, red) compared to [1-3] and optical stereo over the same scene [3] (top, blue).

Temporal consistency shows coarse but roughly consistent depth over two example video sequences.

**Summary**

Cross-spectral stereo, outperforming [1-3], is demonstrated using dense gradient features [4]. Future work will consider advanced dense descriptors and ground truth evaluation.

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