Introduce

Existing depth acquisition systems generally have limited resolution. Depth upsampling procedure is a highly demanded task in many fields including computer vision and robotics.

The Idea of Residual Interpolation

Residual Interpolation [3] is motivated from the two observations

- When an input image doesn’t have high frequency component, interpolation process is performed more accurately.
- The residual map becomes smooth when there are correlations between a guide image and a depth map.

Residual map is generated by subtracting the tentative estimate from the input LR depth map.

Residual map of the input depth map

Residual map of the output depth map

Proposed Algorithm

Tentative Upsampling

Assuming that the input LR depth $p$ can be expressed as local linear transformation of the guide image $i$, the coefficients are obtained by minimizing the cost function.

$$E(a_i, b_i) = \sum_{p \in W_i} \left( a_i I_{bi} + b_i - p \right)^2 + \alpha \sum_{p \in W_i} \left( a_i I_{bi} + b_i - p \right)^2$$

The local windows are overlapped each other. Therefore, tentative estimate is obtained as follows by taking the weighted average of overlapped coefficients.

$$t_a = a_i^1 I_{bi} + b_i$$

Experimental Results

The qualitative and quantitative comparison on the Middlebury dataset [4].

- Upsampling Results: The visual comparison of the x8 upsampling results

- Error maps: The absolute difference between the ground truth

- Numerical Performance: RMSE [mm]

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References

The MATLAB® code of our proposed method is available on the project page!

http://www.ok.isti.titech.ac.jp/res/DSR/RI.html