Natural Image Stitching with the Global Similarity Prior

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Abstract
This paper proposes a method for stitching multiple images together so that the stitched image looks as natural as possible. A comprehensive evaluation shows that the proposed method consistently outperforms several state-of-the-art methods, including AutoStitch, APAP, SPHP and ANNAP.

Method
Mesh Optimization
\[ \hat{V} = \arg \min_V \Psi_a(V) + \Psi_l(V) + \Psi_g(V) \]

1. Alignment Term
   • ghost removal

2. Local Similarity Term
   • shape preserving

3. Global Similarity Term
   • naturalness

|-------------------|---------------------------------|--------------------------|---------------------------------|------|

Rotation selection
\[ \theta_i \equiv (u_i, v_i) \]

2D Method
\[ E_{MLDR} + \lambda_z E_{ZERO}, \text{ where} \]
\[ E_{ZERO} = \sum_{i \in \Omega} \left\| \begin{bmatrix} u_i \\ v_i \end{bmatrix} - \begin{bmatrix} 1 \\ 0 \end{bmatrix} \right\|^2 \]
\[ E_{MLDR} = \sum_{(i,j) \in \mathcal{J}} \left\| R(\phi^{ij}) \begin{bmatrix} u_i \\ v_i \end{bmatrix} - \begin{bmatrix} u_j \\ v_j \end{bmatrix} \right\|^2 \]

3D Method
\[ E_{MLDR} + \lambda_r E_{ALPHA}, \text{ where} \]
\[ E_{ALPHA} = \sum_{(i,j) \in \mathcal{O}} \left\| R(\alpha^{ij}) \begin{bmatrix} u_i \\ v_i \end{bmatrix} - \begin{bmatrix} u_j \\ v_j \end{bmatrix} \right\|^2 \]
\[ E_{MLDR} = \sum_{(i,j) \in \mathcal{O}} \left\| R(\phi^{ij}) \begin{bmatrix} u_i \\ v_i \end{bmatrix} - \begin{bmatrix} u_j \\ v_j \end{bmatrix} \right\|^2 \]

Scale selection
\[ s_i = f_0 / f_i \]

Estimate focal length by bundle adjustment with better initialization and point matches.

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