Joint Super-Resolution and Optical Flow Estimation

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Outline

Outline

Introduction

- Super-Resolution
  - Enhance resolution of images

16 input images   Super-resolution $\xi = 3$ Bicubic

...   ...

Proposed method
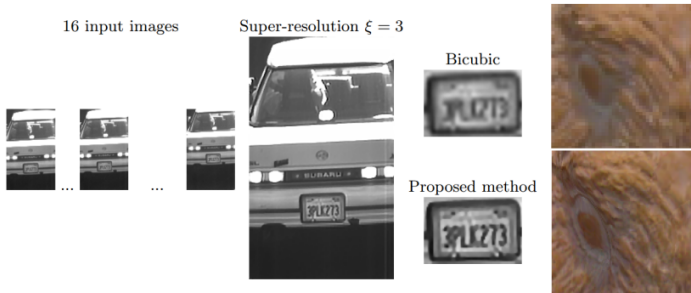
Introduction

- Optical Flow Estimation
  - Estimate the movement in the images

Outline

Energy Minimization Approach

Input Images:

Alternating Optimization:

$$v^{k+1} \leftarrow \underset{v}{\text{argmin}}\, E(u^k, v)$$

$$u^{k+1} \leftarrow \underset{u}{\text{argmin}}\, E(u, v^{k+1})$$

Energy Minimization Approach

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Defined by energy $E(u, v)$

Energy Minimization Approach

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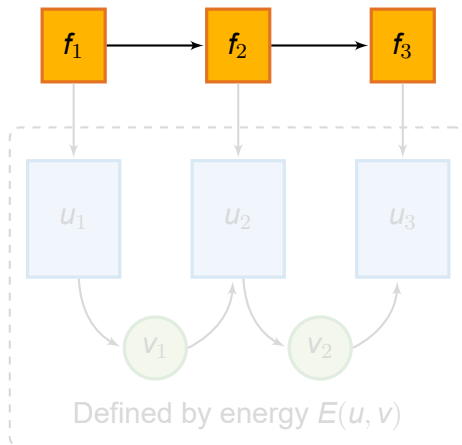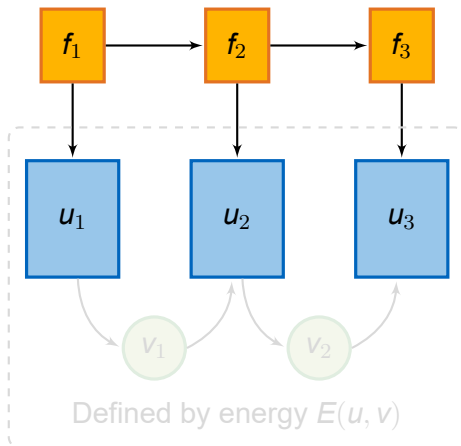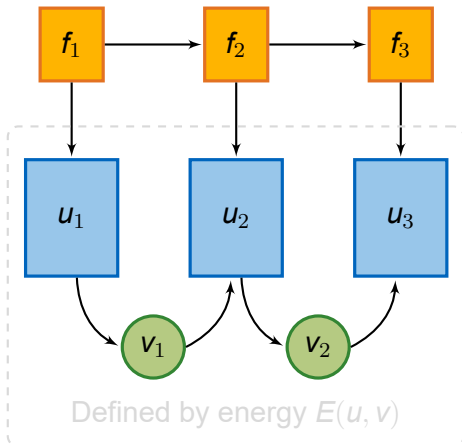
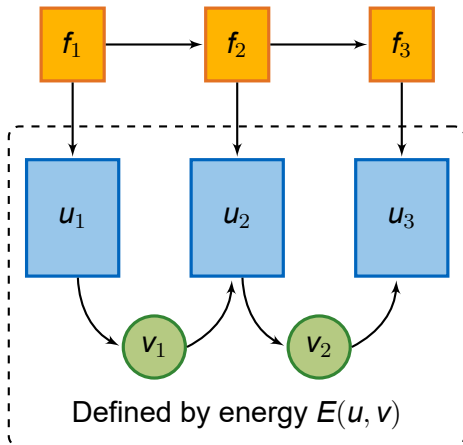Input Images:

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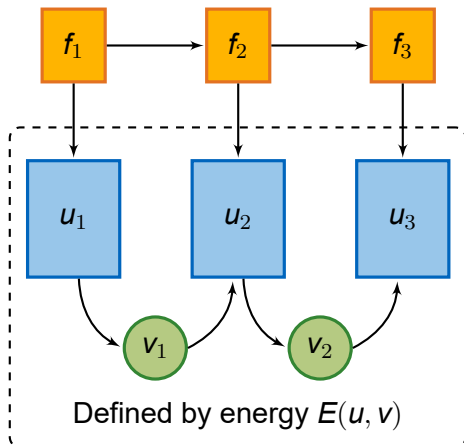
Alternating Optimization:

$$v^{k+1} \leftarrow \operatorname*{argmin}_{v} E(u^k, v)$$

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Flow Field Energy

- Optical Flow Constraint: $u_i(x) \overset{!}{=} u_{i+1}(x + v_i(x))$

  $\rightarrow$ minimize $||u_t - \nabla u^T \cdot v||_1$

- Total Variation: $TV(v)$

$$E_{flow}(v) = \gamma ||u_t - \nabla u^T \cdot v||_1 + TV(v)$$

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Super-Resolution Energy

- Super-Resolution

  $\rightarrow$ minimize: $||Au - f||_1$

- Optical Flow Contraint

  $\rightarrow$ minimize: $||u_t - \nabla u^T \cdot v||_1$

- Total Variation: $TV(u)$

$$E_{super}(u) = \alpha||Au - f||_1 + \beta TV(u) + \gamma||u_t - \nabla u^T \cdot v||_1$$

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Total Energy

$$E_{flow}(v) = \gamma ||u_t - \nabla u^T \cdot v||_1 + TV(v)$$

\+

$$E_{super}(u) = \alpha ||Au - f||_1 + \beta TV(u) + \gamma ||u_t - \nabla u^T \cdot v||_1$$

$\downarrow$

$$E(u, v) = \underbrace{\alpha ||Au - f||_1 + \beta TV(u)}_{\text{Super-Resolution}} + \underbrace{TV(v)}_{\text{Flow}} + \underbrace{\gamma ||u_t - \nabla u^T \cdot v||_1}_{\text{Coupling}}$$
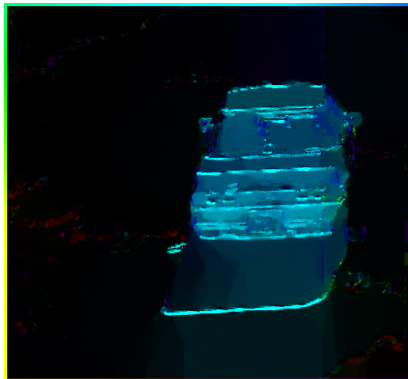
Outline

Results

- Optical Flow Estimation
  - Live Demo ...

Results

- **Super-Resolution with Optical Flow Estimation**
  - Input:

Input 1   Input 2

Results

- Super-Resolution with Optical Flow Estimation
  - Result:

Super-Resolution 1   Input 1

Results

- Super-Resolution with Optical Flow Estimation
  - Result zoom:

Outline

Conclusion and Future Work

- More than two input images
- Arbitrary scaling
- Optical flow estimation for movements > 1 Pixel

End

Thank you for your attention!