2019

High-speed Video from Asynchronous Camera Array (Poster)

Si Lu
Portland State University, lusi@pdx.edu

Citation Details

Lu, Si, "High-speed Video from Asynchronous Camera Array (Poster)" (2019). *Computer Science Faculty Publications and Presentations*. 207.
https://pdxscholar.library.pdx.edu/compsci_fac/207

High-speed Video from Asynchronous Camera Array

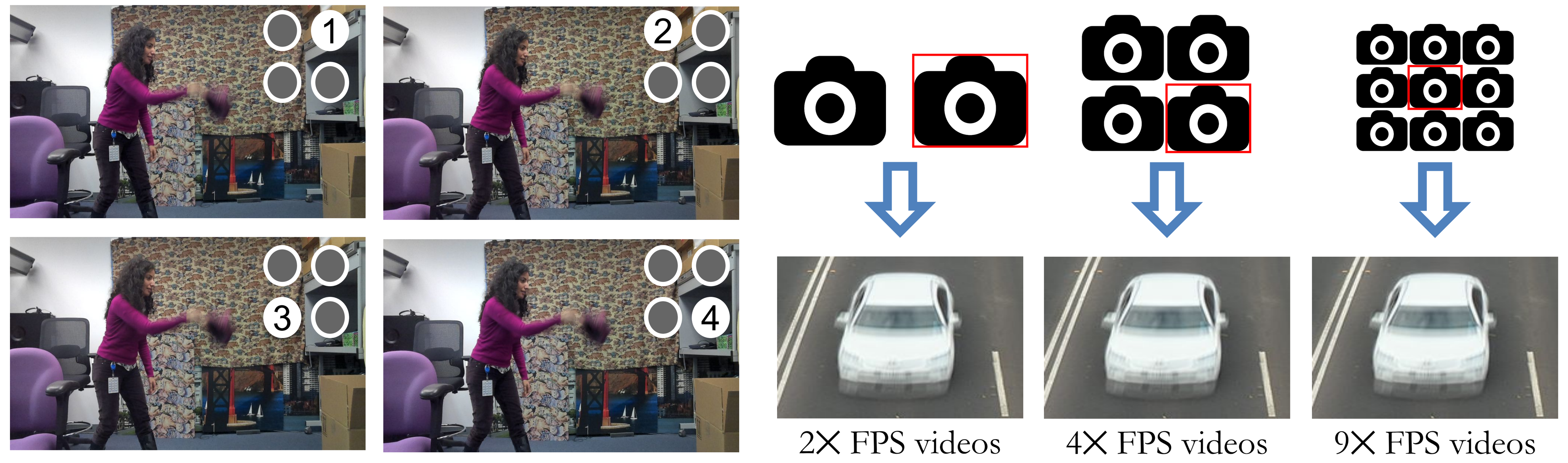
Portland State University

Si Lu, Computer Graphics & Vision Lan, Portland State University
web.cecs.pdx.edu/~lusi/

IEEE 2019 Winter Conference on Applications of Computer Vision

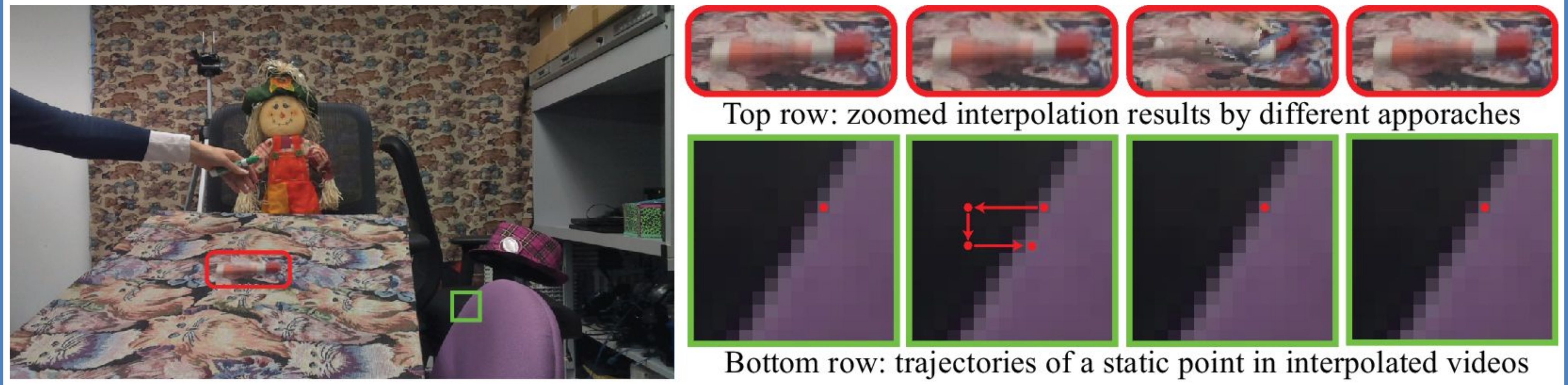
Overview and Motivation

- Explores camera arrays for high-speed videography
- Sequentially firing each sensor in a camera array with a small time offset
- An economic solution for high-speed video capturing: using cheap normal-speed sensors
- Could flexibly exploit expensive high speed (FPS) cameras → generate videos with even higher FPS
- Better meet the demand for high data throughput from high-speed imaging than a single-sensor camera



Related Works

- Traditional optical flow methods do not work well at object boundaries or in textureless regions
- Existing edge-aware approaches perform better at object boundaries, but could not handle large motions
- Optical flow errors can occur and lead to noticeable visual artifacts when using flow-based interpolation
- Adaptive CNN & content-aware CNN achieves STOA performance, but can not handle fast moving objects
- Our method differs from those frame interpolation methods in that we have extra frames that are captured at the same time but from different viewpoints.



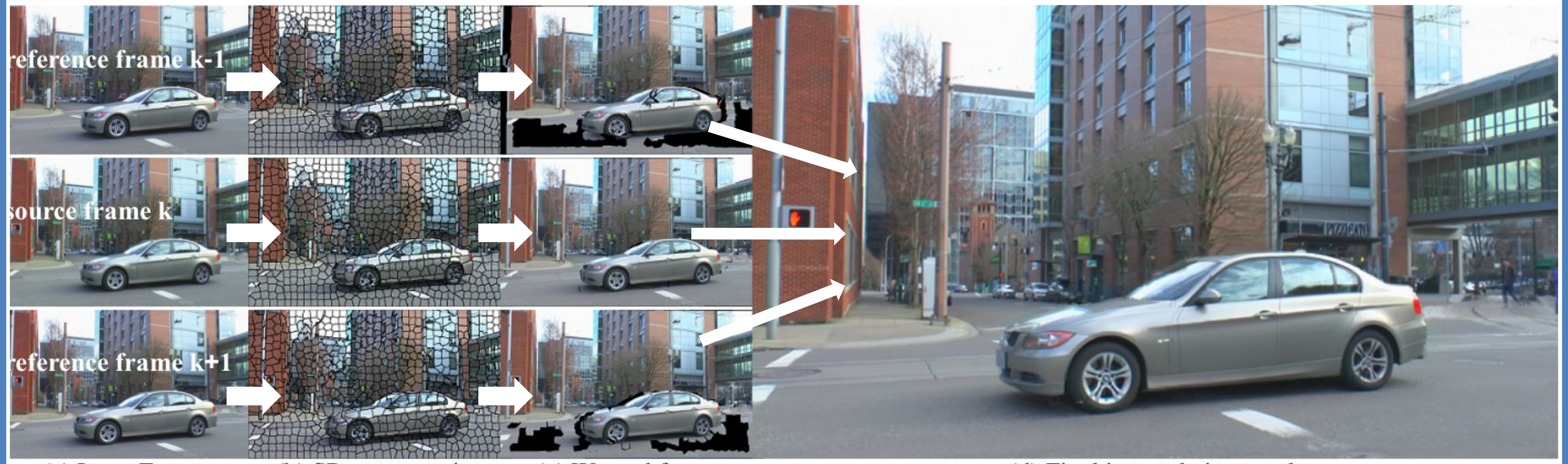
(a) Source frame (b) Ground truth (c) GCPW (d) CMP (e) Ours

Frame synthesis for high-speed video. (a): a source frame. (b): ground truth of the interpolated content (top) and the trajectory (bottom) of a static pixel. Global content-preserving warp (GCPW) [24] suffers from parallax jittering in local regions as shown in (c) bottom. A state-of-the-art optical flow-based method (CMP) [17] cannot handle blurry object as shown in (d) top. Our method produces visually plausible results as shown in (e).

- The key enabling algorithm is a high-quality novel view synthesis algorithm that transforms video frames captured by spatially-distributed lenses as if they were captured by a common lens to avoid parallax jittering.
- This novel view synthesis method uses **local spatially-varying warping & multi-label MRF optimization.**
- Produce plausible novel views from multiple frames while avoiding ghosting artifacts & handling parallax

Methodologyt: Framework

- Optical flow guided local warp
- Labeling-based Rendering

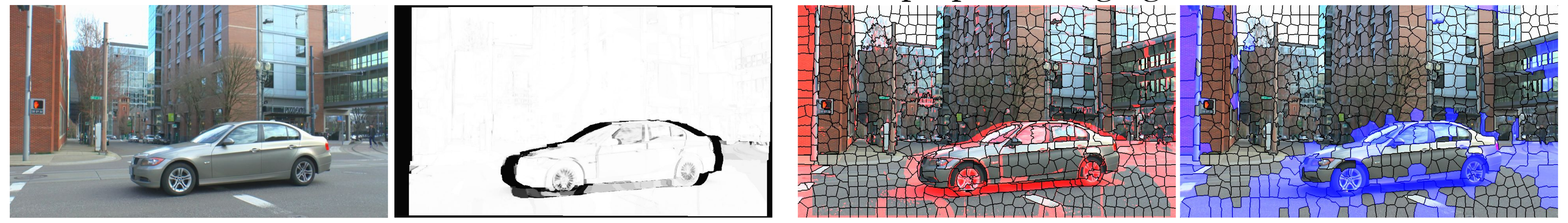


(a) Input Frames (b) SP segmentation (c) Warped frames (d) Final interpolating result

An example of our method. The three input frames (a), including two reference frames and one source frame, are over-segmented into superpixels (SP) (b), locally warped to the target position (c), and blended using our multi-label based optimization scheme (d).

Methodology: Optical flow Guided Local Warp

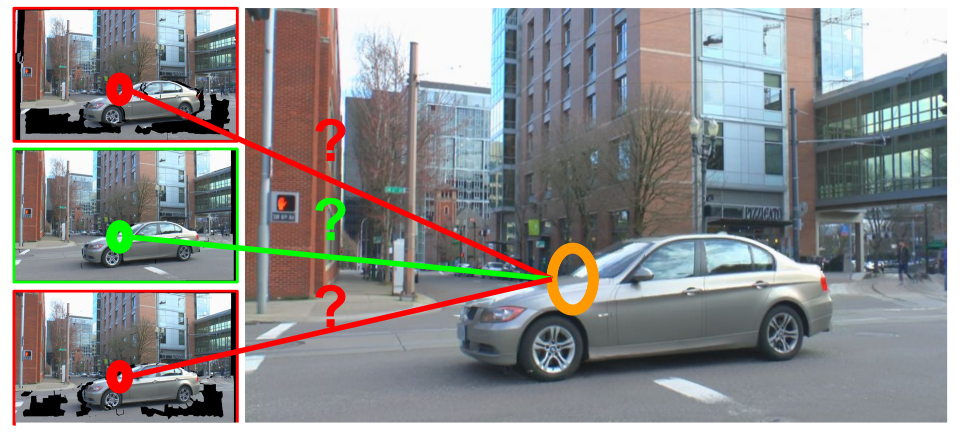
- Optical flow validation
- Superpixel merging



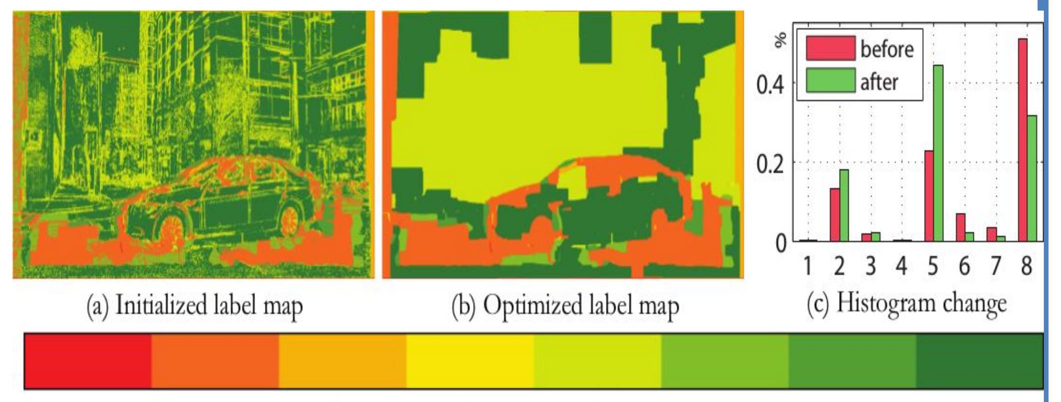
intensity patch matching + forward/backward optical flow check — Original super pixels — Super pixels after merging

- Local content-preserving warp

Methodology: Labeling-based Rendering

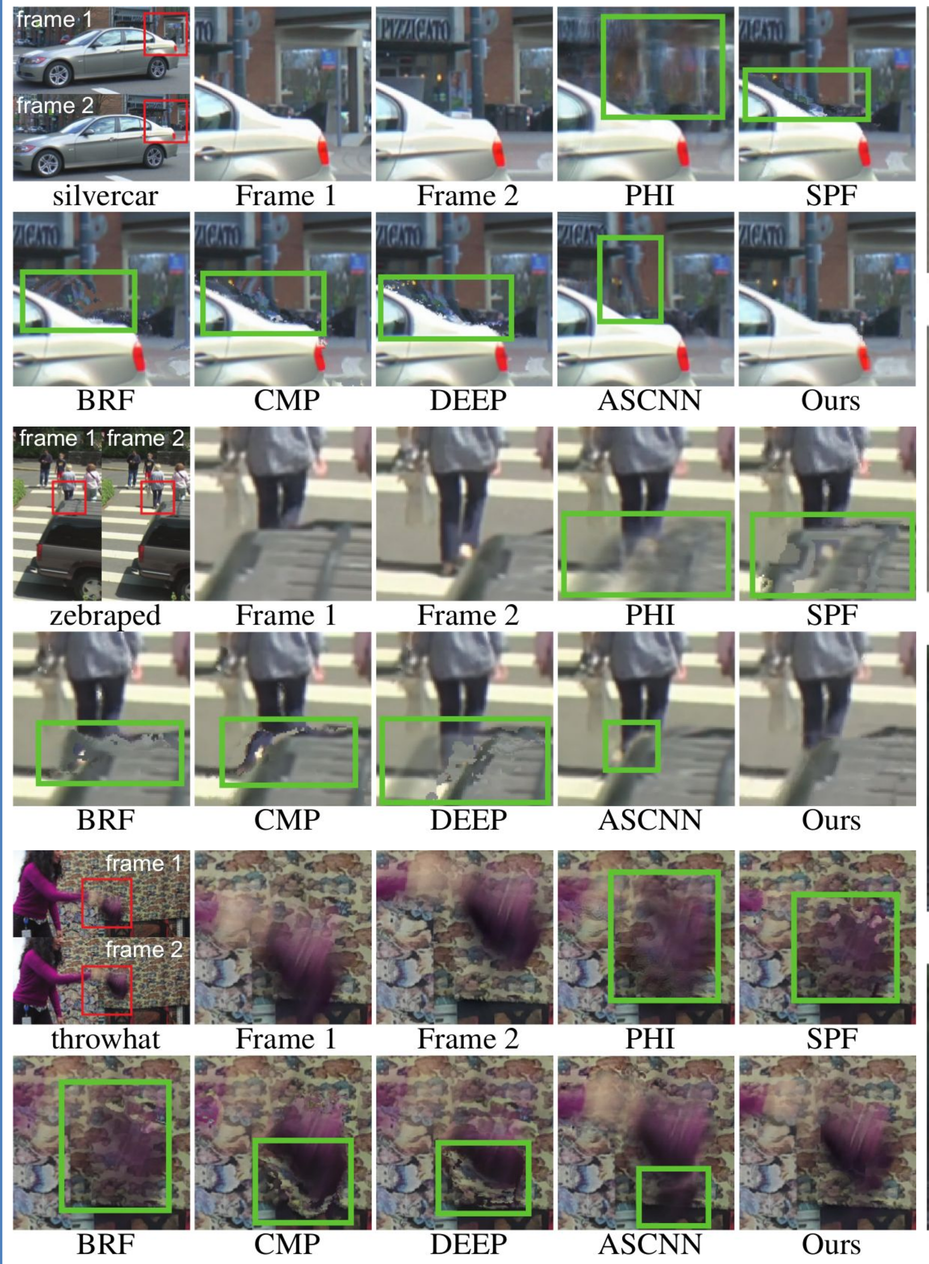


$$E^L = E^L_{data} + \gamma_L \cdot E^L_{smooth}$$

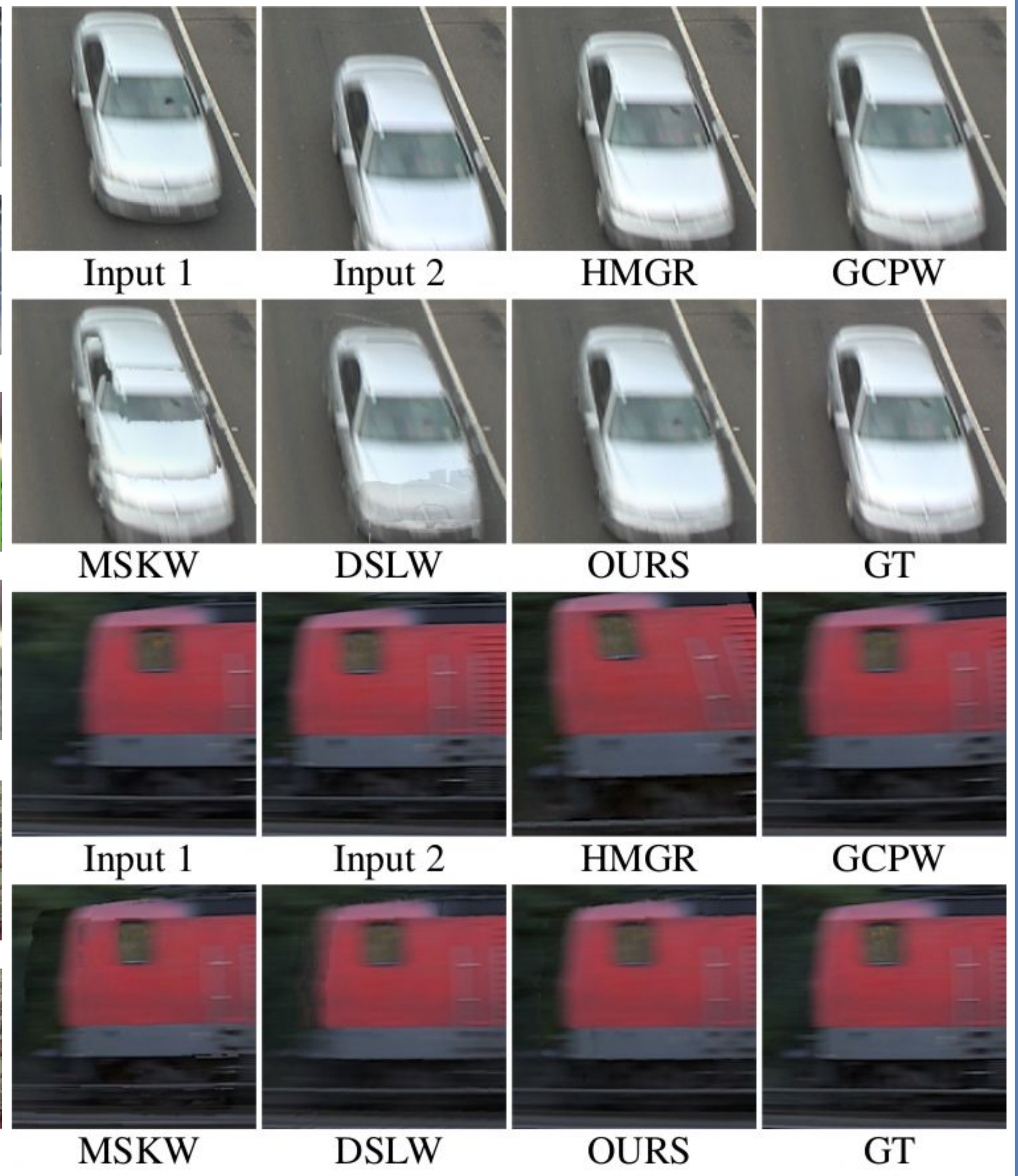


(a): Initialized label map. (b): The final optimized label. (c): Label histogram comparison before and after optimization

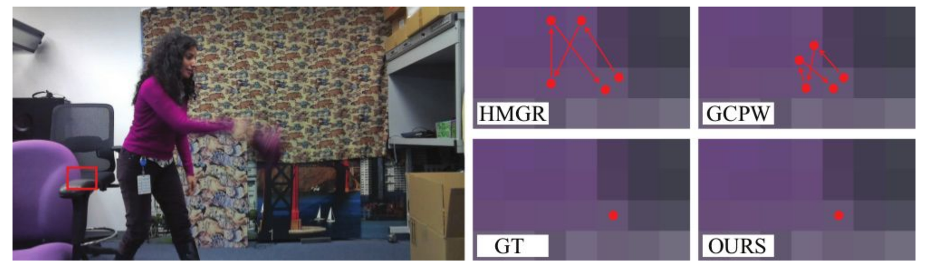
Experiment Results



Comparison to single-lens interpolation methods



Comparison to warp-based approaches



HMGR fails to align the static background features. GCPW performs better, but still suffers from moderate parallax jittering.

(a) OPF_{out} (b) SPM_{out} (c) LAB_{out} (d) Our result
Leave-one-out evaluation of our method

Acknowledgements. This project was in part supported by a gift award from Intel.