## **Robust Interpolation of Correspondences for Large Displacement Optical Flow** Yinlin Hu Yunsong Li Rui Song



# Contributions

- A fast noise-tolerant interpolation of correspondences:
- based on simple RANSAC and fast model propagation
- yields state-of-the-art optical flow results



# **Motivations**

- Optical flow using "Matching + interpolation" has shown great success. [EpicFlow, 2015]
- Matching noise in modern matching methods is inevitable.
- Noise-tolerant interpolation.



Example of matching noise

# Main Ideas

- Robust estimation: use local RANSAC algorithm to remove matching outliers adaptively
- Fast estimation: use model propagation in estimating multimodels

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# **Robust Interpolation of Correspondences**





(b) Two examples of support neighbors



(c) Support neighbors after inlier extraction

Robust model estimation

**2** Fast Model propagation:

Hypothesis generation by

support neighbors

Hypothesis propagation

random sampling based on









 $\hat{h}_k = \arg\min(\mathcal{C}(h)), h \in \{h_k\} \cup \{\mathcal{H}_k\}$ 

based on superpixel graph

### Algorithm 1: Robust interpolation of correspondences **Input:** a pair of images $I_1$ , $I_2$ , a set $\mathcal{M}$ of matches **Output:** dense correspondence field $\mathcal{F}: I_1 \to I_2$

- 1 Over-segment  $I_1$  to K superpixels  $\{s_k\}$
- 2 Superpixel flow initialization from  $\mathcal{M}$
- 3 Construct superpixel graph G = (V, E)
- 4 for each superpixel  $s_k$  do
- Model initialization based on superpixel flow
- Get the support neighbors  $\mathcal{N}_n(k)$  of  $s_k$
- Inlier extraction based on model propagation
- Weighted least square optimization on inliers

9 Variational refinement



# **(1)** Piecewise model estimation

 Graph construction based on superpixels.

Find support neighbors using RANSAC for each piece.











## Comparison to the state of the art:

## • MPI-SIntel:

Method	EPE All	EPE Noc	EPE Occ	Time ∼Sec.
RicFlow	5.620	2.765	28.907	5
DDF	5.728	2.623	31.042	60
FlowFields	5.810	2.621	31.799	18
SPM-BP2	5.812	2.754	30.743	42
FullFlow	5.895	2.838	30.793	240
<b>CPM-Flow</b>	5.960	2.990	30.177	4
EpicFlow	6.285	3.060	32.564	17
FGI	6.607	3.101	35.158	15
PH-Flow	7.423	3.795	36.960	800
MDPFlow2	8.445	4.150	43.430	700

## • KITTI 2015:

Method	Out All3	Out Bg3	Out Fg3	Time ∼Sec.
SOF	16.81%	14.63%	27.73%	360
RicFlow	19.52%	18.73%	23.49%	5
PatchBatch	21.69%	19.98%	30.24%	50
DDF	21.92%	20.36%	29.69%	60
DiscreteFlow	22.38%	21.53%	26.68%	180
<b>CPM-Flow</b>	23.23%	22.32%	27.79%	4
FullFlow	24.26%	23.09%	30.11%	240
EpicFlow	27.10%	25.81%	33.56%	15