

Introduction

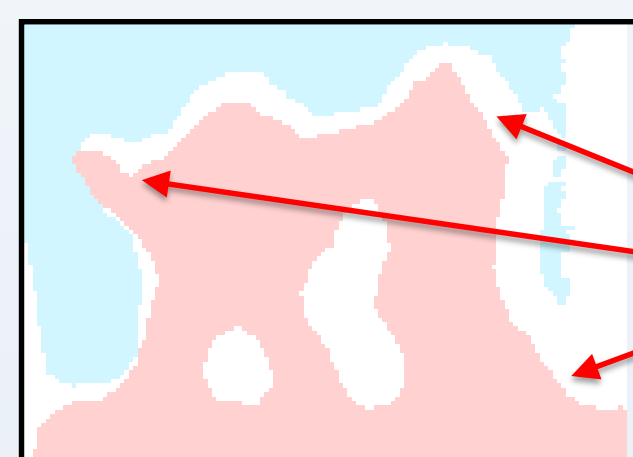
We use Nearest Neighbor Field (NNF) for optical flow estimation

- No distance limitation, can handle large displacements
- Problem 1: Directly applying existing NNF algorithm for optical flow estimation will result in erroneous motion boundaries (see figure below)
- Problem 2: Need large patch size to eliminate matching ambiguities for spatially coherent flow fields (speed concern)
- Problem 3: Need subpixel accuracy

Edge-Preserving PatchMatch

Traditional NNF
(Euclidean Patch Distance)

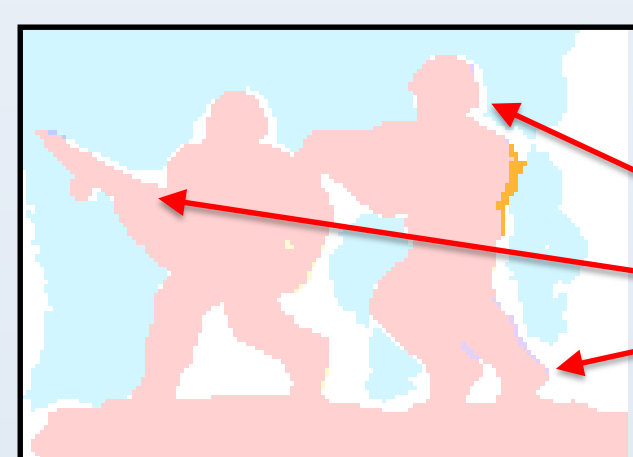
$$\sum_{\Delta} \|I_{\Delta}^1 - I_{\Delta}^2\|^2$$



Erroneous
motion boundary

Our NNF
(Edge-Preserving Patch Distance)

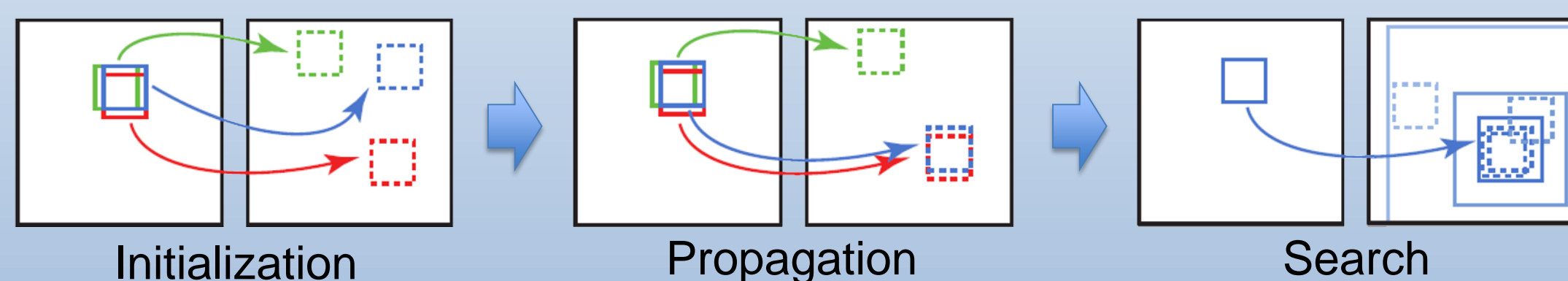
$$\sum_{\Delta} w_s w_r \|I_{\Delta}^1 - I_{\Delta}^2\|$$



Motion boundary
well preserved

w_s Spatial weight
 w_r Range weight } **Bilateral Weighting**

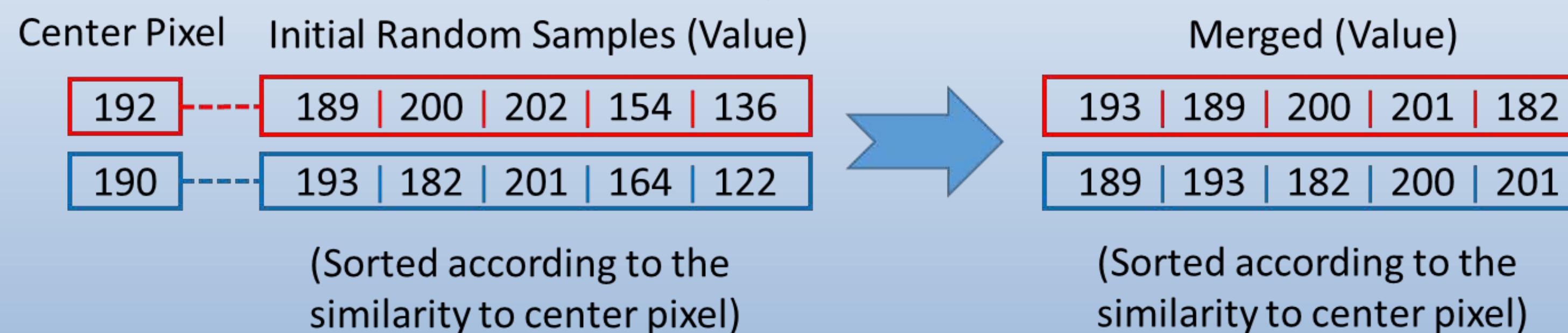
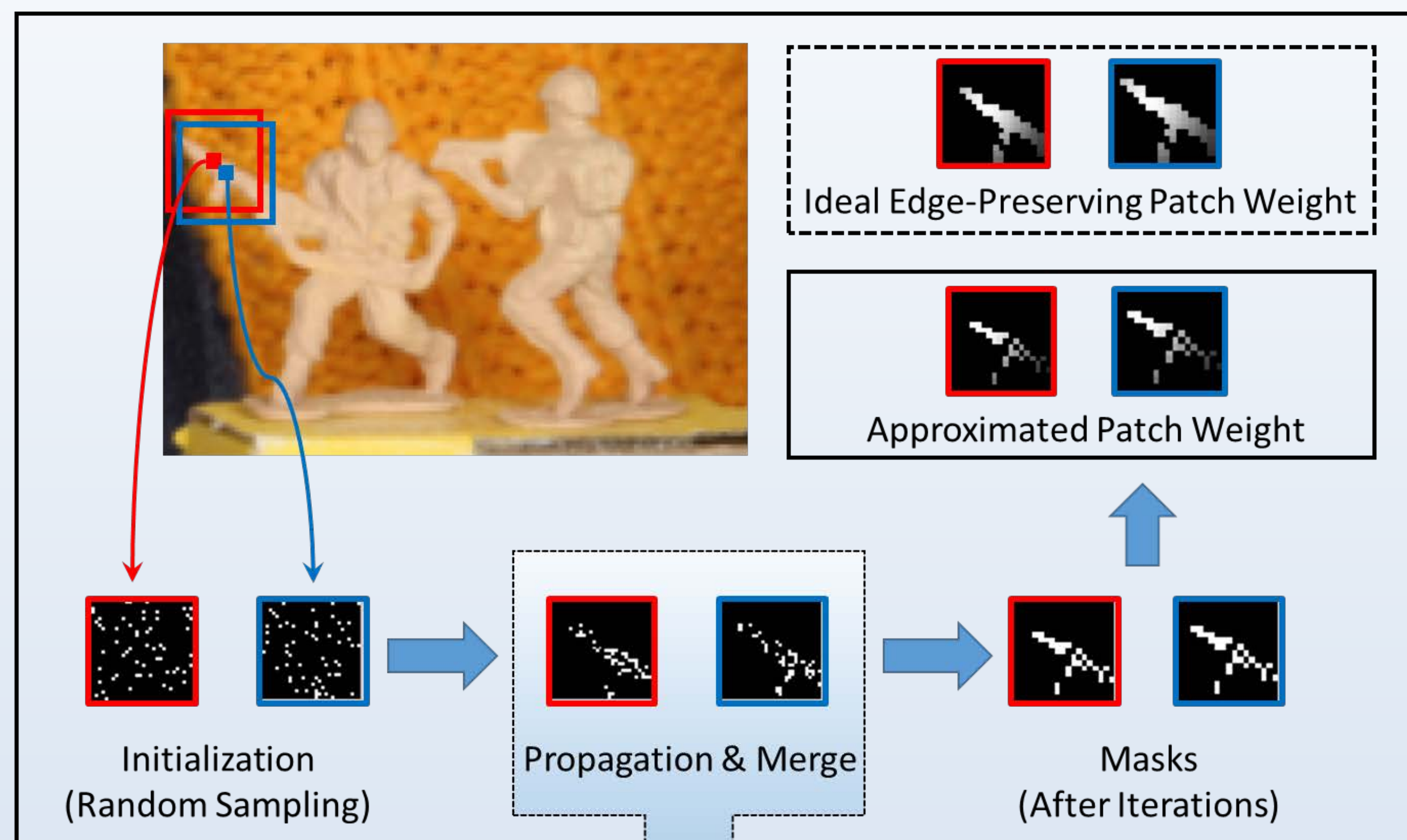
- Fast NNF algorithm: PatchMatch (others not applicable)



- Still **too slow** for large patch size with bilateral weighting

Fast Approximate Algorithm

- Use a few pixels (50 to 100) to represent large patch (35x35)
- Select representative pixels according similarity to center pixel
- A novel randomized algorithm for this selection process (see figure below)
 - ✓ Inspired by PatchMatch
 - ✓ Random initialization, then iteratively propagate and merge
 - ✓ Could be applied to other applications like bilateral filtering approximation



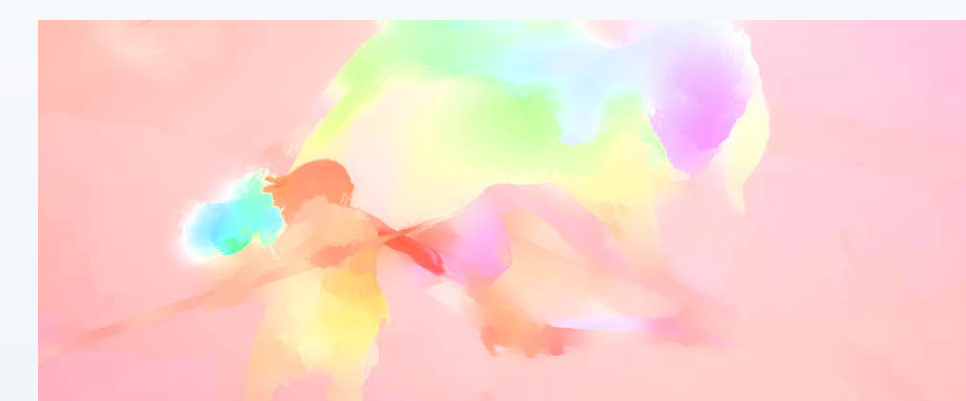
Contributions

- A fast optical flow algorithm that can handle large motion
- A novel self-similarity propagation algorithm
- A high-accuracy subpixel refinement algorithm

Results



Ground Truth



Ours



More...

Performance on MPI Sintel Benchmark

Final Pass	EPE all	EPE s40+	Runtime (sec)
DeepFlow	7.212	44.118	17
S2D-Matching	7.872	48.782	1920
FC-2Layers-FF	8.137	51.349	4525
Classic+NLP	8.291	51.162	888
Ours	8.377	49.083	0.25
MDP-Flow2	8.445	50.507	547
LDOF	9.116	57.296	60
Classic+NL	9.153	60.291	888
Classic++	9.959	64.135	510
Classic+NL-Fast	10.088	67.801	174
Aniso. Huber-L1	11.927	74.796	3.2
...

- The column "EPE s40+" means error over large-motion regions
- Image size is 1024x436 (0.45 Megapixel)
- The runtime are reproduced from reported on Middlebury. Note that not all of them are reported on GPU. Our result is reported on a GTX 780 GPU