Efficient Coarse-to-Fine PatchMatch for Large Displacement Optical Flow

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Main Problems in Optical Flow Estimation

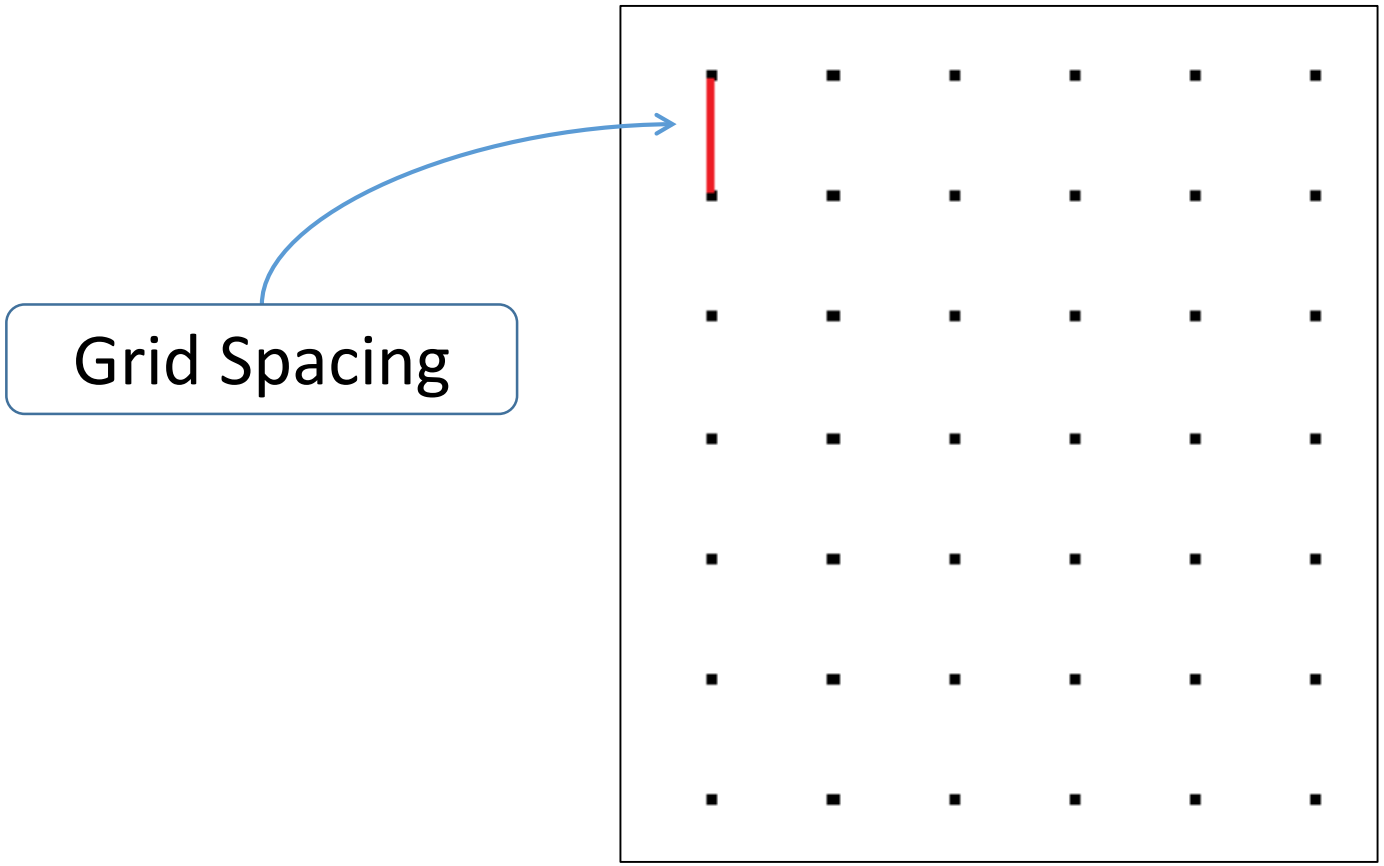
- Large displacements
- Motion discontinuities
- Occlusions

Closely Related Works

- DeepMatching + Edge-preserving interpolation [EpicFlow, CVPR 15]
  - Handles occlusions and motion discontinuities
  - The matching techniques is the bottleneck

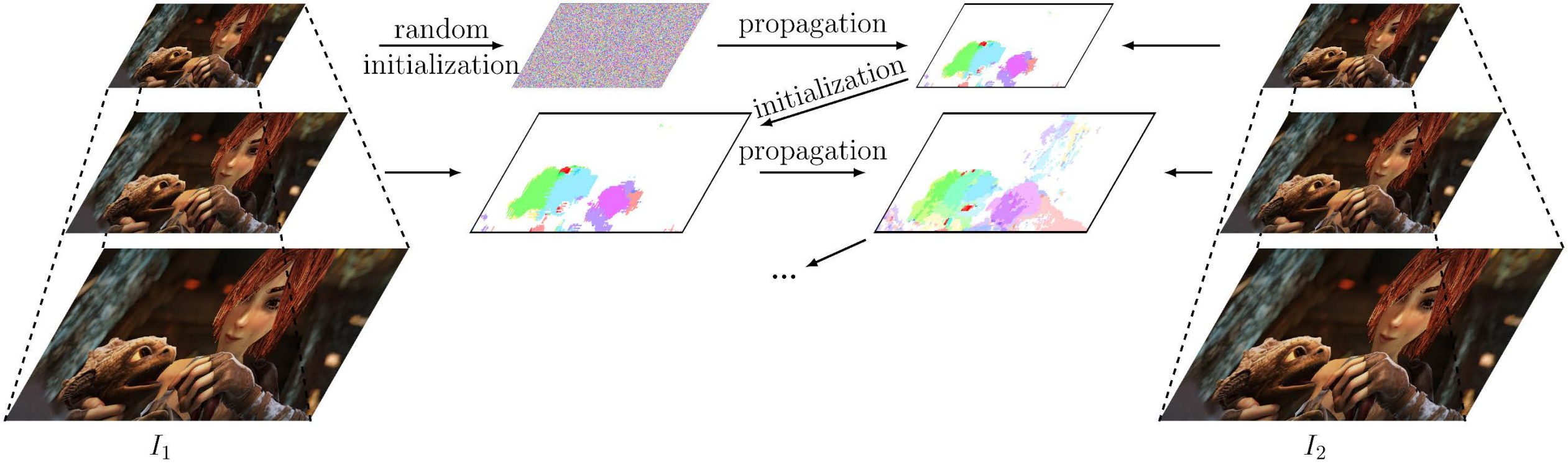
- Nearest Neighbor Fields (NNF) estimation [PatchMatch, Siggraph 09]
  - *Neighborhood propagation* + *random search*
  - Efficient but too noisy for optical flow

PatchMatch on Grid Structure

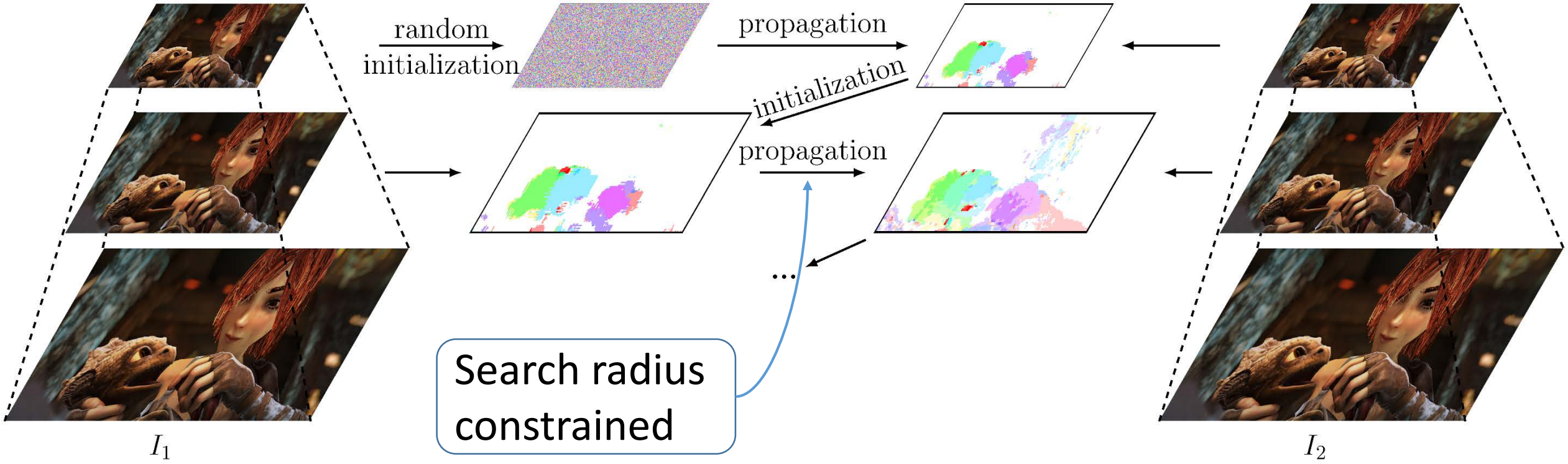


Seeds Selection on Image Grid

Coarse-to-Fine PatchMatch (CPM)



Coarse-to-Fine PatchMatch (CPM)



Comparisons

Input

Ground truth

Comparisons

Our CPM-Flow ~4s

Ground truth

EpicFlow [CVPR 15] ~15s

MDPFlow2 [PAMI 12] ~700s

Comparisons

Input

MDPFlow2 [PAMI 12] ~700s

Comparisons

EpicFlow [CVPR 15] ~15s

Our CPM-Flow ~4s

Comparisons

- Average Endpoint Error:

Method	Error on MPI-Sintel	Error on KITTI	Timings
CPM-Flow	5.96	**3.2**	**4.3s**
FlowFields	**5.81**	3.5	18s
DiscreteFlow	6.08	3.6	~ 180s
EpicFlow	6.29	3.8	16.4s
DeepFlow2	6.93	5.3	17s

Summary

- Coarse-to-Fine PatchMatch
  - A natural heuristics
  - Very simple but effective
  - Generate semi-dense matching efficiently

Thank you