Fast Edge-Preserving PatchMatch for Large Displacement Optical Flow
Supplementary Material

Linchao Bao   Qingxiong Yang   Hailin Jin
City University of Hong Kong   Adobe Systems, Inc.

This document contains supplementary material for the paper "Fast Edge-Preserving PatchMatch for Large Displacement Optical Flow" to be appeared in CVPR 2014. The list of items included here are:

1. Screenshot of MPI Sintel benchmark.
2. Screenshot of KITTI benchmark.
3. Screenshot of Middlebury benchmark.
4. More results on MPI Sintel benchmark.
5. More results on KITTI benchmark.

Besides, a **binary executable demo** for Windows operating systems is provided together with this document (in order to run the program, you should have a CUDA-enabled NVIDIA GPU).

Final Clean

	EPE all	EPE matched	EPE unmatched	d0-10	d10-60	d60-140	s0-10	s10-40	s40+	
GroundTruth [1]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Visualize Results
DeepFlow [2]	5.377	1.771	34.751	4.519	1.534	0.837	0.960	2.730	33.701	Visualize Results
IVANN [3]	5.386	1.397	37.896	2.722	1.341	1.004	0.683	2.245	36.342	Visualize Results
MDP-Flow2 [4]	5.837	1.869	38.158	3.210	1.913	1.441	0.640	2.603	39.459	Visualize Results
EPPM [5]	6.494	2.675	37.632	4.997	2.422	1.948	1.402	3.446	39.152	Visualize Results
S2D-Matching [6]	6.510	2.792	36.785	5.523	3.018	1.546	0.622	3.012	44.187	Visualize Results
Classic+NLP [7]	6.731	2.949	37.545	5.573	3.291	1.648	0.638	3.296	45.290	Visualize Results
FC-2Layers-FF [8]	6.781	3.053	37.144	5.841	3.390	1.688	0.580	3.308	45.962	Visualize Results
LDOF [9]	7.563	3.432	41.170	5.353	3.284	2.454	0.936	2.908	51.696	Visualize Results
Classic+NL [10]	7.961	3.770	42.079	6.191	3.911	2.509	0.573	2.694	57.374	Visualize Results
Classic++ [11]	8.721	4.259	45.047	6.983	4.494	2.753	0.902	3.295	60.645	Visualize Results
Horn+Schunck [12]	8.739	4.525	43.032	7.542	5.045	2.891	1.141	3.860	58.243	Visualize Results
Classic+NL-fast [13]	9.129	4.725	44.956	7.157	4.974	3.331	0.558	2.812	66.935	Visualize Results
SimpleFlow [14]	12.617	7.848	51.435	10.693	8.422	6.170	0.711	8.411	81.786	Visualize Results
AnisoHuber.L1 [15]	12.642	7.983	50.472	10.457	8.675	6.320	0.753	9.976	77.835	Visualize Results
AtrousFlow [16]	14.200	9.584	51.758	11.964	10.338	7.926	1.702	12.440	80.185	Visualize Results

Final Clean

	EPE all	EPE matched	EPE unmatched	d0-10	d10-60	d60-140	s0-10	s10-40	s40+	
GroundTruth [1]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Visualize Results
DeepFlow [2]	5.377	1.771	34.751	4.519	1.534	0.837	0.960	2.730	33.701	Visualize Results
IVANN [3]	5.386	1.397	37.896	2.722	1.341	1.004	0.683	2.245	36.342	Visualize Results
EPPM [4]	6.494	2.675	37.632	4.997	2.422	1.948	1.402	3.446	39.152	Visualize Results
MDP-Flow2 [5]	5.837	1.869	38.158	3.210	1.913	1.441	0.640	2.603	39.459	Visualize Results
S2D-Matching [6]	6.510	2.792	36.785	5.523	3.018	1.546	0.622	3.012	44.187	Visualize Results
Classic+NLP [7]	6.731	2.949	37.545	5.573	3.291	1.648	0.638	3.296	45.290	Visualize Results
FC-2Layers-FF [8]	6.781	3.053	37.144	5.841	3.390	1.688	0.580	3.308	45.962	Visualize Results
LDOF [9]	7.563	3.432	41.170	5.353	3.284	2.454	0.936	2.908	51.696	Visualize Results
Classic+NL [10]	7.961	3.770	42.079	6.191	3.911	2.509	0.573	2.694	57.374	Visualize Results
Horn+Schunck [11]	8.739	4.525	43.032	7.542	5.045	2.891	1.141	3.860	58.243	Visualize Results
Classic++ [12]	8.721	4.259	45.047	6.983	4.494	2.753	0.902	3.295	60.645	Visualize Results
Classic+NL-fast [13]	9.129	4.725	44.956	7.157	4.974	3.331	0.558	2.812	66.935	Visualize Results
AnisoHuber.L1 [14]	12.642	7.983	50.472	10.457	8.675	6.320	0.753	9.976	77.835	Visualize Results
AtrousFlow [15]	14.200	9.584	51.758	11.964	10.338	7.926	1.702	12.440	80.185	Visualize Results
SimpleFlow [16]	12.617	7.848	51.435	10.693	8.422	6.170	0.711	8.411	81.786	Visualize Results

Figure 1: Average endpoint error (EPE) ranking on MPI Sintel benchmark – clean pass (captured on *Oct 30th, 2013*). The second figure is the ranking by only considering large displacement motions (flow velocity larger than 40 pixels per frame)

Final Clean

	EPE all	EPE matched	EPE unmatched	d0-10	d10-60	d60-140	s0-10	s10-40	s40+	
GroundTruth [1]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Visualize Results
DeepFlow [2]	7.212	3.336	38.781	5.650	3.144	2.208	1.284	4.107	44.118	Visualize Results
IVANN [3]	7.249	2.973	42.088	4.896	2.817	2.218	1.159	4.183	44.866	Visualize Results
S2D-Matching [4]	7.872	3.918	40.093	5.975	3.815	2.851	1.172	4.695	48.782	Visualize Results
FC-2Layers-FF [5]	8.137	4.261	39.723	6.537	4.257	2.946	1.034	4.835	51.349	Visualize Results
Classic+NLP [6]	8.291	4.287	40.925	6.520	4.265	2.984	1.208	5.090	51.162	Visualize Results
EPPM [7]	8.377	4.286	41.695	6.556	4.024	3.323	1.834	4.955	49.083	Visualize Results
MDP-Flow2 [8]	8.445	4.150	43.430	5.703	3.925	3.406	1.420	5.449	50.507	Visualize Results
LDOF [9]	9.116	5.037	42.344	6.849	4.928	4.003	1.485	4.839	57.296	Visualize Results
Classic+NL [10]	9.153	4.814	44.509	7.215	4.822	3.427	1.113	4.496	60.291	Visualize Results
Horn+Schunck [11]	9.610	5.419	43.734	7.950	5.658	3.976	1.882	5.335	58.274	Visualize Results
Classic++ [12]	9.959	5.410	47.000	8.072	5.554	3.750	1.403	5.098	64.135	Visualize Results
Classic+NL-fast [13]	10.088	5.659	46.145	8.010	5.738	4.160	1.092	4.666	67.801	Visualize Results
AnisoHuber.L1 [14]	11.927	7.323	49.366	9.464	7.692	5.929	1.155	7.966	74.796	Visualize Results
SimpleFlow [15]	13.364	8.620	51.949	10.872	8.884	7.171	1.475	9.582	81.350	Visualize Results
AtrousFlow [16]	14.173	9.573	51.548	11.511	10.027	8.092	2.011	12.052	79.484	Visualize Results

Final Clean

	EPE all	EPE matched	EPE unmatched	d0-10	d10-60	d60-140	s0-10	s10-40	s40+	
GroundTruth [1]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Visualize Results
DeepFlow [2]	7.212	3.336	38.781	5.650	3.144	2.208	1.284	4.107	44.118	Visualize Results
IVANN [3]	7.249	2.973	42.088	4.896	2.817	2.218	1.159	4.183	44.866	Visualize Results
S2D-Matching [4]	7.872	3.918	40.093	5.975	3.815	2.851	1.172	4.695	48.782	Visualize Results
EPPM [5]	8.377	4.286	41.695	6.556	4.024	3.323	1.834	4.955	49.083	Visualize Results
MDP-Flow2 [6]	8.445	4.150	43.430	5.703	3.925	3.406	1.420	5.449	50.507	Visualize Results
Classic+NLP [7]	8.291	4.287	40.925	6.520	4.265	2.984	1.208	5.090	51.162	Visualize Results
FC-2Layers-FF [8]	8.137	4.261	39.723	6.537	4.257	2.946	1.034	4.835	51.349	Visualize Results
LDOF [9]	9.116	5.037	42.344	6.849	4.928	4.003	1.485	4.839	57.296	Visualize Results
Horn+Schunck [10]	9.610	5.419	43.734	7.950	5.658	3.976	1.882	5.335	58.274	Visualize Results
Classic+NL [11]	9.153	4.814	44.509	7.215	4.822	3.427	1.113	4.496	60.291	Visualize Results
Classic++ [12]	9.959	5.410	47.000	8.072	5.554	3.750	1.403	5.098	64.135	Visualize Results
Classic+NL-fast [13]	10.088	5.659	46.145	8.010	5.738	4.160	1.092	4.666	67.801	Visualize Results
AnisoHuber.L1 [14]	11.927	7.323	49.366	9.464	7.692	5.929	1.155	7.966	74.796	Visualize Results
AtrousFlow [15]	14.173	9.573	51.548	11.511	10.027	8.092	2.011	12.052	79.484	Visualize Results
SimpleFlow [16]	13.364	8.620	51.949	10.872	8.884	7.171	1.475	9.582	81.350	Visualize Results

Figure 2: Average endpoint error (EPE) ranking on MPI Sintel benchmark – final pass (captured on *Oct 30th, 2013*). The second figure is the ranking by only considering large displacement motions (flow velocity larger than 40 pixels per frame).

Error threshold 5 pixels   Evaluation area All pixels

Optical Flow Evaluation

This table ranks general optical flow methods, performing a full 2D search, as compared to the motion stereo methods below.

Rank	Method	Setting	Code	Out-Noc	Out-All	Avg-Noc	Avg-All	Density	Runtime	Environment	Compare
1	SceneFlow			**1.83 %**	**3.59 %**	**0.8 px**	1.3 px	100.00 %	6 min	4 cores @ 3.0 Ghz (Matlab + C/C++)	
Anonymous submission											
2	PR-Sf+E			2.34 %	4.79 %	0.9 px	1.7 px	100.00 %	200 s	4 cores @ 3.0 Ghz (Matlab + C/C++)	
C. Vogel, S. Roth and K. Schindler: Piecewise Rigid Scene Flow. International Conference on Computer Vision (ICCV) 2013.											
3	PCBP-Flow			2.58 %	6.26 %	0.9 px	2.2 px	100.00 %	3 min	4 cores @ 2.5 Ghz (Matlab + C/C++)	
K. Yamaguchi, D. McAllester and R. Urtasun: Robust Monocular Epipolar Flow Estimation. CVPR 2013.											
4	PR-Sceneflow			2.65 %	5.38 %	1.2 px	2.8 px	100.00 %	150 sec	4 core @ 3.0 Ghz (Matlab + C/C++)	
C. Vogel, S. Roth and K. Schindler: Piecewise Rigid Scene Flow. International Conference on Computer Vision (ICCV) 2013.											
5	MotionSLIC			2.74 %	8.12 %	1.0 px	2.7 px	100.00 %	11 s	1 core @ 3.0 Ghz (C/C++)	
K. Yamaguchi, D. McAllester and R. Urtasun: Robust Monocular Epipolar Flow Estimation. CVPR 2013.											
6	gtRF-DF			4.52 %	10.45 %	1.6 px	4.3 px	100.00 %	1 min	1 core @ 2.5 Ghz (Matlab + C/C++)	
Anonymous submission											
7	TGV2ADCSIFT			4.71 %	12.19 %	1.6 px	4.5 px	100.00 %	12s	GPU @ 2.4 Ghz (C/C++)	
8	TVL1-HOG			5.37 %	15.54 %	2.0 px	6.1 px	100.00 %	180 s	2 cores @ 3.0 Ghz (Matlab)	
H. Rashwan, M. Mohamed, M. Garcia, B. Mertsching and D. Puig: Illumination Robust Optical Flow Model Based on Histogram of Oriented Gradients. German Conference on Pattern Recognition 2013 .											
9	DeepFlow			5.38 %	14.70 %	1.5 px	5.8 px	100.00 %	17 s	1 core @ 3.6Ghz (Python + C/C++)	
P. Weinzaepfel, J. Revaud, Z. Harchaoui and C. Schmid: DeepFlow: Large displacement optical flow with deep matching. IEEE Intenational Conference on Computer Vision (ICCV) 2013.											
10	Data-Flow			5.44 %	11.77 %	1.9 px	5.5 px	100.00 %	3 min	2 cores @ 2.5 Ghz (Matlab + C/C++)	
C. Vogel, S. Roth and K. Schindler: An Evaluation of Data Costs for Optical Flow. German Conference on Pattern Recognition (GCPR) 2013.											
11	DescFlow			6.26 %	15.59 %	2.1 px	5.7 px	100.00 %	9.0 s	GPU @ 2.5 Ghz (C/C++)	
Anonymous submission											
12	MLDP-OF			6.87 %	15.91 %	2.5 px	6.7 px	100.00 %	160 s	2 cores @ 2.5 Ghz (Matlab)	
Anonymous submission											
13	CRTflow			6.90 %	15.02 %	2.7 px	6.5 px	100.00 %	18 s	GPU @ 1.0 Ghz (C/C++)	
O. Demetz, D. Hafner and J. Weickert: The Complete Rank Transform: A Tool for Accurate and Morphologically Invariant Matching of Structure. Proc.~British Machine Vision Conference 2013 (BMVC) 2013.											
14	C++		code	8.04 %	17.14 %	2.6 px	7.1 px	100.00 %	8.5 min	1 core @ 3.0 Ghz (Matlab)	
D. Sun, S. Roth and M. Black: A Quantitative Analysis of Current Practices in Optical Flow Estimation and The Principles Behind Them. 2013.											
15	IVANN			8.33 %	17.92 %	2.7 px	7.4 px	100.00 %	1073 s	1 core @ 2.5 Ghz (Matlab)	
Anonymous submission											
16	C+NL		code	8.34 %	17.35 %	2.8 px	7.2 px	100.00 %	14.8 min	1 core @ 3.0 Ghz (Matlab)	
D. Sun, S. Roth and M. Black: A Quantitative Analysis of Current Practices in Optical Flow Estimation and The Principles Behind Them. 2013.											
17	fSGM			8.44 %	20.63 %	3.2 px	12.2 px	100.00 %	60 s	1 core @ 2.4 Ghz (C/C++)	
S. Hermann and R. Klette: Hierarchical Scan Line Dynamic Programming for Optical Flow using Semi-Global Matching. ACCV Workshops 2012.											
18	EPPM		code	8.62 %	18.86 %	2.5 px	9.2 px	100.00 %	0.25 s	GPU @ 1.0 Ghz (C/C++)	
Anonymous submission											
19	TGV2CENSUS		code	9.19 %	15.68 %	2.9 px	6.6 px	100.00 %	4 s	GPU+CPU @ 3.0 Ghz (Matlab + C/C++)	
M. Werlberger: Convex Approaches for High Performance Video Processing. 2012. R. Ranftl, S. Gehrig, T. Pock and H. Bischof: Pushing the Limits of Stereo Using Variational Stereo Estimation. IV 2012.											
20	C+NL-fast		code	10.13 %	19.07 %	3.2 px	7.8 px	100.00 %	2.9 min	1 core @ 3.0 Ghz (Matlab)	
D. Sun, S. Roth and M. Black: A Quantitative Analysis of Current Practices in Optical Flow Estimation and The Principles Behind Them. 2013.											
21	HS		code	12.47 %	21.00 %	4.0 px	9.0 px	100.00 %	2.6 min	1 core @ 3.0 Ghz (Matlab)	
D. Sun, S. Roth and M. Black: A Quantitative Analysis of Current Practices in Optical Flow Estimation and The Principles Behind Them. 2013.											
22	IQFlow			14.23 %	23.53 %	3.6 px	8.8 px	100.00 %	60 s	4 cores @ 3.5 Ghz (C/C++)	
Anonymous submission											
23	GC-BM-Bino			15.31 %	25.80 %	5.0 px	12.0 px	83.73 %	1.3 s	2 cores @ 2.5 Ghz (C/C++)	
B. Kitt and H. Lategahn: Trinocular Optical Flow Estimation for Intelligent Vehicle Applications. ITSC 2012.											
24	GC-BM-Mono			15.42 %	25.93 %	5.0 px	12.1 px	84.33 %	1.3 s	2 cores @ 2.5 Ghz (C/C++)	
B. Kitt and H. Lategahn: Trinocular Optical Flow Estimation for Intelligent Vehicle Applications. ITSC 2012.											
25	eFolki			16.52 %	25.60 %	5.2 px	10.8 px	100.00 %	0.026 s	GPU @ 700 Mhz (C/C++)	
Anonymous submission											
26	C+NL-M			17.22 %	24.34 %	7.4 px	14.5 px	100.00 %	5 min	2 cores @ 2.5 Ghz (Matlab)	
Anonymous submission											
27	HMM			18.21 %	27.83 %	7.2 px	15.0 px	100.00 %	10 min	1 core @ 2.5 Ghz (C/C++)	
Anonymous submission											
28	ALD			18.34 %	27.22 %	10.9 px	16.0 px	100.00 %	110 s	1 core @ 2.5 Ghz (C/C++)	
M. Stoll, S. Volz and A. Bruhn: Adaptive Integration of Feature Matches into Variational Optical Flow Methods. ACCV 2012.											
29	RSRS-Flow			18.65 %	27.13 %	6.2 px	12.1 px	100.00 %	4 min	1 core @ 2.5 Ghz (Matlab)	
P. Ghosh and B. Manjunath: Robust Simultaneous Registration and Segmentation with Sparse Error Reconstruction. PAMI 2012.											
30	LDOF		code	18.72 %	27.97 %	5.5 px	12.4 px	100.00 %	1 min	1 core @ 2.5 Ghz (C/C++)	
T. Brox and J. Malik: Large Displacement Optical Flow: Descriptor Matching in Variational Motion Estimation. PAMI 2011.											
31	GCSF			26.33 %	35.64 %	7.0 px	15.3 px	48.27 %	2.4 s	1 core @ 2.5 Ghz (C/C++)	
J. Cech, J. Sanchez-Riera and R. Horaud: Scene Flow Estimation by Growing Correspondence Seeds. CVPR 2011.											
32	DB-TV-L1		code	26.50 %	35.10 %	7.8 px	14.6 px	100.00 %	16 s	1 core @ 2.5 Ghz (Matlab)	
C. Zach, T. Pock and H. Bischof: A Duality Based Approach for Realtime TV-L1 Optical Flow. DAGM 2007.											
33	BERLOF			30.63 %	39.00 %	8.5 px	16.2 px	15.26 %	0.231 s	GPU @ 700 Mhz (C/C++) GeForce GTX 680	
T. Senst, J. Geistert, I. Keller and T. Sikora: Robust Local Optical Flow Estimation using Bilinear Equations for Sparse Motion Estimation. 20th IEEE International Conference on Image Processing 2013.											
34	RLOF		code	31.49 %	39.83 %	8.7 px	16.5 px	14.76 %	0.488 s	GPU @ 700 Mhz (C/C++) GeForce GTX 680	
T. Senst, V. Eiselein and T. Sikora: Robust Local Optical Flow for Feature Tracking. TCSVT 2012.											
35	HAOF		code	32.48 %	40.12 %	11.1 px	18.2 px	100.00 %	16.2 s	1 core @ 2.5 Ghz (C/C++)	
T. Brox, A. Bruhn, N. Papenberg and J. Weickert: High accuracy optical flow estimation based on a theory for warping. ECCV 2004.											
36	PolyExpand			44.53 %	51.03 %	17.2 px	25.2 px	100.00 %	1 s	1 core @ 2.5 Ghz (C/C++)	
G. Farneback: Two-Frame Motion Estimation Based on Polynomial Expansion. SCIA 2003.											
37	Pyramid-LK		code	57.22 %	62.72 %	21.7 px	33.1 px	99.90 %	1.5 min	1 core @ 2.5 Ghz (Matlab)	
J. Bouguet: Pyramidal implementation of the Lucas Kanade feature tracker. Intel 2000.											
38	OCV-BM		code	60.41 %	65.49 %	24.4 px	33.3 px	100.00 %	1.5 min	1 core @ 2.5 Ghz (C/C++)	
G. Bradski: The OpenCV Library. Dr. Dobb's Journal of Software Tools 2000.											
39	MEDIAN			66.55 %	71.52 %	16.0 px	23.9 px	99.94 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	
40	AVERAGE			67.92 %	72.68 %	16.3 px	24.6 px	99.94 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	

This table as LaTeX

The settings column describes additional assumptions made / information used by the methods:

- **ms** = motion stereo: Usage of the epipolar geometry to restrict the search problem to 1D

Figure 3: Bad pixel ranking (threshold 5 pixels) on KITTI benchmark (captured on *Oct 30th, 2013*). Note that in the "setting" column, more than one icon means the method is not a pure optical flow estimation method.

Optical flow evaluation results

Statistics: Average SD R0.5 R1.0 R2.0 A50 A75 A95

Show images: below table above table in window

Error type: endpoint angle interpolation normalized interpolation

Average endpoint error	avg. rank	Army (Hidden texture) GT im0 im1 all	disc	untext	Mequon (Hidden texture) GT im0 im1 all	disc	untext	Schefflera (Hidden texture) GT im0 im1 all	disc	untext	Wooden (Hidden texture) GT im0 im1 all	disc	untext	Grove (Synthetic) GT im0 im1 all	disc	untext	Urban (Synthetic) GT im0 im1 all	disc	untext	Yosemite (Synthetic) GT im0 im1 all	disc	untext	Teddy (Stereo) GT im0 im1 all	disc	untext
IVANN [91]	2.6	0.07 1	0.20 2	0.05 1	0.15 1	0.51 3	0.12 5	0.18 1	0.37 1	0.14 1	0.10 2	0.49 3	0.06 2	0.41 1	0.61 1	0.21 2	0.23 2	0.66 2	0.19 1	0.10 4	0.12 8	0.17 11	0.34 1	0.80 4	0.23 2
OFLAF [80]	6.6	0.08 7	0.21 3	0.06 5	0.16 5	0.53 4	0.12 5	0.19 2	0.37 1	0.14 1	0.14 7	0.77 21	0.07 4	0.51 4	0.78 5	0.25 3	0.31 4	0.76 3	0.25 6	0.11 10	0.12 8	0.21 29	0.42 7	0.78 2	0.63 12
MDP-Flow2 [69]	7.5	0.08 7	0.21 3	0.07 14	0.15 1	0.48 1	0.11 1	0.20 4	0.40 4	0.14 1	0.15 17	0.80 26	0.08 11	0.63 13	0.93 14	0.43 14	0.26 3	0.76 3	0.23 5	0.11 10	0.12 8	0.17 11	0.38 3	0.79 3	0.44 4
NN-field [72]	8.3	0.08 7	0.22 13	0.05 1	0.17 7	0.55 6	0.13 10	0.19 2	0.39 3	0.15 6	0.09 1	0.48 2	0.05 1	0.41 1	0.61 1	0.20 1	0.52 42	0.64 1	0.26 9	0.13 30	0.13 26	0.20 22	0.35 2	0.83 5	0.21 1
Epistemic [81]	9.6	0.07 1	0.21 3	0.05 1	0.16 5	0.55 6	0.12 5	0.20 4	0.44 7	0.15 6	0.11 3	0.65 6	0.06 2	0.71 26	1.07 30	0.53 27	0.32 6	1.06 18	0.28 11	0.11 10	0.13 26	0.15 7	0.41 6	0.88 9	0.54 5
TC/T-Flow [79]	14.3	0.07 1	0.21 3	0.05 1	0.19 13	0.68 24	0.12 5	0.28 17	0.66 22	0.14 1	0.14 7	0.86 31	0.07 4	0.67 22	0.98 21	0.49 23	0.22 1	0.82 5	0.19 1	0.11 10	0.11 1	0.30 66	0.50 24	1.02 26	0.64 15
Layers++ [37]	15.6	0.08 7	0.21 3	0.07 14	0.19 13	0.56 8	0.17 24	0.20 4	0.40 4	0.18 17	0.13 6	0.58 4	0.07 4	0.48 3	0.70 3	0.33 6	0.47 29	1.01 13	0.33 30	0.15 49	0.14 44	0.24 41	0.46 13	0.88 9	0.72 26
ADF [66]	15.7	0.08 7	0.22 13	0.06 5	0.18 9	0.62 15	0.14 14	0.29 22	0.71 27	0.17 12	0.16 28	0.91 39	0.07 4	0.69 24	1.03 24	0.47 18	0.43 18	0.91 8	0.28 11	0.12 20	0.12 8	0.20 22	0.43 8	0.88 9	0.63 12
LME [71]	15.9	0.08 7	0.22 13	0.06 5	0.15 1	0.49 2	0.11 1	0.30 26	0.64 17	0.31 63	0.15 17	0.78 23	0.09 23	0.66 18	0.96 18	0.53 27	0.33 7	1.18 28	0.28 11	0.12 20	0.12 8	0.18 15	0.44 9	0.91 12	0.61 10
IROF++ [58]	16.5	0.08 7	0.23 18	0.07 14	0.21 24	0.68 24	0.17 24	0.28 17	0.63 16	0.19 27	0.15 17	0.73 17	0.09 23	0.60 10	0.89 10	0.42 13	0.43 18	1.08 21	0.31 21	0.10 4	0.12 8	0.12 4	0.47 15	0.98 20	0.68 23
nLayers [57]	16.7	0.07 1	0.19 1	0.06 5	0.22 29	0.59 10	0.19 42	0.25 12	0.54 11	0.20 36	0.15 17	0.84 29	0.08 11	0.53 5	0.78 5	0.34 8	0.44 22	0.84 6	0.30 18	0.13 30	0.13 26	0.20 22	0.47 15	0.97 19	0.67 20
FC-2Layers-FF [76]	18.7	0.08 7	0.21 3	0.07 14	0.21 24	0.70 28	0.17 24	0.20 4	0.40 4	0.18 17	0.15 17	0.76 20	0.08 11	0.53 5	0.77 4	0.37 9	0.49 35	1.02 14	0.33 30	0.16 59	0.13 26	0.29 61	0.44 9	0.87 8	0.64 15
Correlation Flow [78]	18.7	0.09 27	0.23 18	0.07 14	0.17 7	0.58 9	0.11 1	0.43 41	0.99 44	0.15 6	0.11 3	0.47 1	0.08 11	0.75 31	1.08 31	0.56 31	0.41 15	0.92 9	0.30 18	0.14 39	0.13 26	0.27 53	0.40 5	0.85 6	0.42 3
AGIF+OF [89]	20.2	0.08 7	0.22 13	0.07 14	0.23 41	0.73 33	0.18 33	0.28 17	0.66 22	0.18 17	0.14 7	0.70 9	0.08 11	0.57 7	0.85 7	0.38 10	0.47 29	0.97 11	0.31 21	0.13 30	0.13 26	0.22 33	0.51 29	0.99 23	0.74 34
TC-Flow [46]	21.6	0.07 1	0.21 3	0.06 5	0.15 1	0.59 10	0.11 1	0.31 31	0.78 34	0.14 1	0.16 28	0.86 31	0.08 11	0.75 31	1.11 33	0.54 29	0.42 17	1.40 43	0.25 6	0.11 10	0.12 8	0.29 61	0.62 37	1.35 37	0.93 49
FESL [74]	21.7	0.08 7	0.21 3	0.07 14	0.25 49	0.75 39	0.19 42	0.27 13	0.61 14	0.18 17	0.14 7	0.68 7	0.08 11	0.61 12	0.89 10	0.44 15	0.47 29	1.03 16	0.32 25	0.14 39	0.15 54	0.25 45	0.50 24	0.96 17	0.63 12
Classic+CPF [87]	21.7	0.08 7	0.23 18	0.07 14	0.22 29	0.73 33	0.17 24	0.30 26	0.70 25	0.18 17	0.14 7	0.72 16	0.08 11	0.63 13	0.93 14	0.45 17	0.51 39	1.03 16	0.32 25	0.14 39	0.12 8	0.30 66	0.48 18	0.93 13	0.72 26
ALD-Flow [67]	21.8	0.07 1	0.21 3	0.06 5	0.19 13	0.64 20	0.13 10	0.30 26	0.73 29	0.15 6	0.17 33	0.92 43	0.07 4	0.78 34	1.14 34	0.59 34	0.33 7	1.30 35	0.21 3	0.12 20	0.12 8	0.28 56	0.54 33	1.19 35	0.73 30
SCR [73]	21.8	0.08 7	0.23 18	0.07 14	0.22 29	0.71 29	0.17 24	0.27 13	0.60 13	0.19 27	0.14 7	0.73 17	0.08 11	0.63 13	0.92 13	0.44 15	0.51 39	1.08 21	0.33 30	0.15 49	0.13 26	0.29 61	0.47 15	0.93 13	0.67 20
COFM [59]	22.1	0.08 7	0.26 35	0.06 5	0.18 9	0.62 15	0.14 14	0.30 26	0.74 31	0.19 27	0.15 17	0.86 31	0.07 4	0.79 35	1.14 34	0.74 50	0.35 10	0.87 7	0.28 11	0.14 39	0.12 8	0.28 56	0.49 20	0.94 15	0.71 25
Sparse-NonSparse [56]	22.3	0.08 7	0.23 18	0.07 14	0.22 29	0.73 33	0.18 33	0.28 17	0.64 17	0.19 27	0.14 7	0.71 13	0.08 11	0.67 22	0.99 23	0.48 21	0.49 35	1.06 18	0.32 25	0.14 39	0.11 1	0.28 56	0.49 20	0.98 20	0.73 30
Efficient-NL [60]	22.5	0.08 7	0.22 13	0.06 5	0.21 24	0.67 22	0.17 24	0.31 31	0.73 29	0.18 17	0.14 7	0.71 13	0.08 11	0.59 9	0.88 9	0.39 11	1.30 69	1.35 38	0.67 65	0.14 39	0.13 26	0.26 47	0.45 11	0.85 6	0.55 7
LSM [39]	23.8	0.08 7	0.23 18	0.07 14	0.22 29	0.73 33	0.18 33	0.28 17	0.64 17	0.19 27	0.14 7	0.70 9	0.09 23	0.66 18	0.97 19	0.48 21	0.50 37	1.06 18	0.33 30	0.15 49	0.12 8	0.29 61	0.50 24	0.99 23	0.73 30
Ramp [62]	24.4	0.08 7	0.24 26	0.07 14	0.21 24	0.72 31	0.18 33	0.27 13	0.62 15	0.19 27	0.15 17	0.71 13	0.09 23	0.66 18	0.97 19	0.49 23	0.51 39	1.09 23	0.34 36	0.15 49	0.12 8	0.30 66	0.48 18	0.96 17	0.72 26
Classic+NL [31]	26.3	0.08 7	0.23 18	0.07 14	0.22 29	0.74 37	0.18 33	0.29 22	0.65 21	0.19 27	0.15 17	0.73 17	0.09 23	0.64 17	0.93 14	0.47 18	0.52 42	1.12 25	0.33 30	0.16 59	0.13 26	0.29 61	0.49 20	0.98 20	0.74 34
TV-L1-MCT [64]	26.5	0.08 7	0.23 18	0.07 14	0.24 45	0.77 41	0.19 42	0.32 34	0.76 33	0.19 27	0.14 7	0.69 8	0.09 23	0.72 28	1.03 24	0.60 35	0.54 44	1.10 24	0.35 37	0.11 10	0.12 8	0.20 22	0.54 33	1.04 30	0.84 41
PMF [75]	27.0	0.09 27	0.25 29	0.07 14	0.19 13	0.60 13	0.14 14	0.23 9	0.46 9	0.17 12	0.17 33	0.87 35	0.09 23	0.58 8	0.86 8	0.26 4	0.82 58	1.17 26	0.54 56	0.21 80	0.22 85	0.36 77	0.39 4	0.75 1	0.59 9
IROF-TV [53]	28.6	0.09 27	0.25 29	0.08 34	0.22 29	0.77 41	0.19 42	0.30 26	0.70 25	0.19 27	0.18 38	0.93 46	0.11 40	0.73 29	1.04 27	0.56 31	0.44 22	1.69 58	0.31 21	0.09 3	0.11 1	0.12 4	0.50 24	1.08 32	0.73 30
MDP-Flow [26]	29.3	0.09 27	0.25 29	0.08 34	0.19 13	0.54 5	0.18 33	0.24 10	0.55 12	0.20 36	0.16 28	0.91 39	0.09 23	0.74 30	1.06 29	0.61 37	0.46 26	1.02 14	0.35 37	0.12 20	0.14 44	0.17 11	0.78 54	1.68 58	0.97 54
EPPM [92]	31.1	0.11 43	0.30 51	0.08 34	0.19 13	0.67 22	0.13 10	0.29 22	0.71 27	0.17 12	0.17 33	0.78 23	0.11 40	0.63 13	0.93 14	0.33 6	0.60 48	1.35 38	0.40 47	0.19 72	0.15 54	0.45 84	0.45 11	0.94 15	0.64 15
OFH [38]	31.2	0.10 38	0.25 29	0.09 46	0.19 13	0.69 26	0.14 14	0.43 41	1.02 47	0.17 12	0.17 33	1.08 52	0.08 11	0.87 43	1.25 41	0.73 47	0.43 18	1.69 58	0.32 25	0.10 4	0.13 26	0.18 15	0.59 36	1.40 41	0.74 34
Sparse Occlusion [54]	32.2	0.09 27	0.24 26	0.08 34	0.22 29	0.63 17	0.19 42	0.38 38	0.91 38	0.18 17	0.17 33	0.85 30	0.09 23	0.75 31	1.09 32	0.47 18	0.34 9	1.00 12	0.26 9	0.22 82	0.22 85	0.28 56	0.53 32	1.13 33	0.67 20
CostFilter [40]	33.0	0.10 38	0.27 41	0.08 34	0.20 22	0.63 17	0.15 19	0.22 8	0.45 8	0.18 17	0.19 42	0.88 37	0.12 44	0.60 10	0.90 12	0.28 5	0.75 55	1.19 29	0.50 53	0.21 80	0.24 89	0.40 81	0.46 13	1.02 26	0.62 11
NL-TV-NCC [25]	33.2	0.10 38	0.26 35	0.08 34	0.22 29	0.72 31	0.15 19	0.35 36	0.85 36	0.16 10	0.15 17	0.70 9	0.09 23	0.79 35	1.16 37	0.51 25	0.78 56	1.38 40	0.48 52	0.16 59	0.15 54	0.26 47	0.55 35	1.16 34	0.55 7
S2D-Matching [88]	33.3	0.09 27	0.26 35	0.07 14	0.23 41	0.80 48	0.18 33	0.38 38	0.93 39	0.20 36	0.15 17	0.70 9	0.09 23	0.70 25	1.03 24	0.51 25	0.55 46	1.17 26	0.35 37	0.17 65	0.13 26	0.32 73	0.51 29	1.01 25	0.81 39
Aniso-Texture [86]	35.1	0.08 7	0.21 3	0.07 14	0.19 13	0.60 13	0.17 24	0.50 50	1.11 51	0.21 41	0.12 5	0.58 4	0.07 4	0.93 54	1.28 49	0.92 59	0.46 26	1.27 32	0.38 46	0.20 73	0.20 82	0.30 66	0.68 42	1.37 39	0.88 45
SimpleFlow [49]	35.5	0.09 27	0.24 26	0.08 34	0.24 45	0.78 44	0.20 51	0.43 41	0.96 42	0.21 41	0.16 28	0.77 21	0.09 23	0.71 26	1.04 27	0.55 30	1.47 74	1.59 54	0.76 68	0.13 30	0.12 8	0.22 33	0.50 24	1.04 30	0.72 26
Occlusion-TV-L1 [63]	35.9	0.09 27	0.26 35	0.07 14	0.22 29	0.74 37	0.18 33	0.51 52	1.15 56	0.21 41	0.18 38	0.91 39	0.10 37	0.87 43	1.25 41	0.72 44	0.47 29	1.38 40	0.36 41	0.10 4	0.12 8	0.11 2	0.83 58	1.78 61	0.96 53
Adaptive [20]	38.9	0.09 27	0.26 35	0.06 5	0.23 41	0.78 44	0.18 33	0.54 56	1.19 61	0.21 41	0.18 38	0.91 39	0.10 37	0.88 46	1.25 41	0.73 47	0.50 37	1.28 33	0.31 21	0.14 39	0.16 62	0.22 33	0.65 41	1.37 39	0.79 37
Complementary OF [21]	40.5	0.11 43	0.28 42	0.10 56	0.18 9	0.63 17	0.12 5	0.31 31	0.75 32	0.18 17	0.19 42	0.97 47	0.12 44	0.97 60	1.31 56	1.00 64	1.78 83	1.73 61	0.87 76	0.11 10	0.12 8	0.22 33	0.68 42	1.48 43	0.95 50
TCOF [70]	40.5	0.11 43	0.28 42	0.09 46	0.24 45	0.76 40	0.19 42	0.53 53	1.15 56	0.29 59	0.24 54	0.88 37	0.20 65	0.88 46	1.26 45	0.69 41	0.38 11	0.93 10	0.29 16	0.16 59	0.16 62	0.22 33	0.49 20	1.03 29	0.65 18
DPOF [18]	40.7	0.12 59	0.33 60	0.08 34	0.26 52	0.80 48	0.20 51	0.24 10	0.49 10	0.20 36	0.19 42	0.83 28	0.13 48	0.66 18	0.98 21	0.40 12	1.11 65	1.41 45	0.57 60	0.25 87	0.14 44	0.55 87	0.51 29	1.02 26	0.54 5
ACK-Prior [27]	40.7	0.11 43	0.25 29	0.09 46	0.18 9	0.59 10	0.13 10	0.27 13	0.64 17	0.16 10	0.15 17	0.78 23	0.09 23	0.82 38	1.14 34	0.71 43	1.90 84	1.90 67	0.99 80	0.23 85	0.17 69	0.49 86	0.77 52	1.44 42	0.91 47
ComplOF-FED-GPU [35]	43.0	0.11 43	0.29 47	0.10 56	0.21 24	0.78 44	0.14 14	0.32 34	0.79 35	0.17 12	0.19 42	0.99 48	0.11 40	0.89 48	1.29 50	0.73 47	1.25 67	1.74 62	0.64 64	0.14 39	0.13 26	0.30 66	0.64 39	1.50 45	0.83 40
Classic++ [32]	43.9	0.09 27	0.25 29	0.07 14	0.23 41	0.78 44	0.19 42	0.43 41	1.00 45	0.22 46	0.20 46	1.11 53	0.10 37	0.87 43	1.30 53	0.66 40	0.47 29	1.62 55	0.33 30	0.17 65	0.14 44	0.32 73	0.79 55	1.64 54	0.92 48
Aniso. Huber-L1 [22]	44.2	0.10 38	0.28 42	0.08 34	0.31 60	0.88 56	0.28 64	0.56 59	1.13 52	0.29 59	0.20 46	0.92 43	0.13 48	0.84 40	1.20 38	0.70 42	0.39 13	1.23 30	0.28 11	0.17 65	0.15 54	0.27 53	0.64 39	1.36 38	0.79 37
CRTflow [84]	45.9	0.11 43	0.30 51	0.08 34	0.24 45	0.77 41	0.17 24	0.50 50	1.13 52	0.21 41	0.23 53	1.24 60	0.12 44	0.86 42	1.27 47	0.65 39	0.60 48	1.95 72	0.50 53	0.12 20	0.14 44	0.21 29	0.79 55	1.77 60	0.98 55
DeepFlow [90]	45.9	0.12 59	0.31 54	0.11 63	0.28 57	0.82 51	0.22 57	0.44 47	1.00 45	0.33 64	0.26 60	1.34 67	0.15 56	0.81 37	1.21 39	0.58 33	0.38 11	1.55 53	0.25 6	0.11 10	0.11 1	0.24 41	0.93 64	1.82 65	1.12 62
TriangleFlow [30]	46.9	0.11 43	0.29 47	0.09 46	0.26 52	0.95 60	0.17 24	0.47 49	1.07 48	0.18 17	0.16 28	0.87 35	0.09 23	1.07 68	1.47 73	1.10 68	0.87 59	1.39 42	0.57 60	0.15 49	0.19 80	0.23 40	0.63 38	1.33 36	0.84 41
SIOF [68]	48.7	0.11 43	0.28 42	0.09 46	0.27 55	0.95 60	0.20 51	0.60 65	1.17 58	0.48 65	0.25 58	1.13 54	0.16 57	0.97 60	1.33 59	1.03 65	0.43 18	1.32 36	0.36 41	0.13 30	0.13 26	0.18 15	0.76 50	1.52 48	1.14 66
TV-L1-improved [17]	49.1	0.09 27	0.26 35	0.07 14	0.20 22	0.71 29	0.16 21	0.53 53	1.18 60	0.22 46	0.21 50	1.24 60	0.11 40	0.90 49	1.31 56	0.72 44	1.51 76	1.93 70	0.84 72	0.18 70	0.17 69	0.31 71	0.73 47	1.62 53	0.87 44
CBF [12]	50.2	0.10 38	0.28 42	0.09 46	0.34 64	0.80 48	0.37 67	0.43 41	0.95 41	0.26 52	0.21 50	1.14 55	0.13 48	0.90 49	1.27 47	0.82 54	0.41 15	1.23 30	0.30 18	0.23 85	0.19 80	0.39 80	0.76 50	1.56 49	1.02 56
LocallyOriented [52]	50.3	0.12 59	0.35 64	0.08 34	0.33 63	1.01 64	0.25 61	0.61 67	1.30 69	0.28 56	0.18 38	0.80 26	0.13 48	0.93 54	1.29 50	0.79 52	0.98 62	1.48 49	0.56 59	0.12 20	0.14 44	0.21 29	0.73 47	1.48 43	0.95 50
Local-TV-L1 [65]	52.0	0.14 67	0.34 61	0.14 71	0.47 70	1.05 66	0.43 70	0.72 71	1.25 66	0.52 66	0.31 68	1.39 70	0.22 67	0.83 39	1.21 39	0.63 38	0.39 13	1.29 34	0.29 16	0.11 10	0.11 1	0.22 33	1.06 69	1.87 67	1.67 75
Brox et al. [5]	52.3	0.11 43	0.32 58	0.11 63	0.27 55	0.93 58	0.22 57	0.39 40	0.94 40	0.24 50	0.24 54	1.25 62	0.13 48	1.10 73	1.39 68	1.43 80	0.89 61	1.77 64	0.55 58	0.10 4	0.13 26	0.11 2	0.91 61	1.83 66	1.13 64
CLG-TV [48]	52.7	0.11 43	0.29 47	0.09 46	0.32 61	0.86 55	0.30 65	0.55 57	1.17 58	0.28 56	0.25 58	1.05 50	0.17 60	0.92 53	1.30 53	0.79 52	0.47 29	1.72 60	0.35 37	0.17 65	0.17 69	0.25 45	0.74 49	1.57 51	0.88 45
F-TV-L1 [15]	52.7	0.14 67	0.35 64	0.14 71	0.34 64	0.98 62	0.26 62	0.59 64	1.19 61	0.26 52	0.27 63	1.36 69	0.16 57	0.90 49	1.30 53	0.76 51	0.54 44	1.62 55	0.36 41	0.13 30	0.15 54	0.20 22	0.68 42	1.56 49	0.66 19
FastOF [77]	53.3	0.11 43	0.31 54	0.10 56	0.35 67	1.05 66	0.27 63	0.60 65	1.14 55	0.52 66	0.22 52	0.92 43	0.16 57	0.95 57	1.29 50	1.10 68	0.67 52	1.92 69	0.51 55	0.15 49	0.12 8	0.22 33	0.81 57	1.50 45	0.95 50
SuperFlow [85]	53.8	0.11 43	0.29 47	0.08 34	0.34 64	0.85 54	0.33 66	0.53 53	1.08 50	0.59 69	0.28 65	1.23 59	0.21 66	0.99 63	1.32 58	1.21 72	0.46 26	1.49 50	0.36 41	0.15 49	0.16 62	0.19 18	0.90 60	1.81 63	1.07 58
Fusion [6]	54.0	0.11 43	0.34 61	0.10 56	0.19 13	0.69 26	0.16 21	0.29 22	0.66 22	0.23 48	0.20 46	1.19 57	0.14 54	1.07 68	1.42 70	1.22 73	1.35 70	1.49 50	0.86 74	0.20 73	0.20 82	0.26 47	1.07 71	2.07 76	1.39 72
Rannacher [23]	54.1	0.11 43	0.31 54	0.09 46	0.25 49	0.84 53	0.21 55	0.57 61	1.27 68	0.26 52	0.24 54	1.32 65	0.13 48	0.91 52	1.33 59	0.72 44	1.49 75	1.95 72	0.78 69	0.15 49	0.14 44	0.26 47	0.69 45	1.58 52	0.86 43
Second-order prior [8]	55.9	0.11 43	0.31 54	0.09 46	0.26 52	0.93 58	0.20 51	0.57 61	1.25 66	0.26 52	0.20 46	1.04 49	0.12 44	0.94 56	1.34 61	0.83 56	0.61 50	1.93 70	0.47 51	0.20 73	0.16 62	0.34 76	0.77 52	1.64 54	1.07 58
p-harmonic [29]	56.6	0.12 59	0.36 69	0.11 63	0.25 49	0.82 51	0.21 55	0.57 61	1.24 63	0.28 56	0.26 60	1.20 58	0.19 64	1.07 68	1.39 68	1.31 76	0.44 22	1.65 57	0.37 45	0.15 49	0.16 62	0.21 29	0.87 59	1.76 59	1.06 57
Bartels [41]	57.7	0.12 59	0.30 51	0.11 63	0.22 29	0.65 21	0.19 42	0.35 36	0.86 37	0.23 48	0.28 65	1.32 65	0.18 62	0.97 60	1.38 65	0.98 61	1.20 66	1.76 63	0.78 69	0.20 73	0.17 69	0.48 85	0.91 61	1.88 68	1.22 67
Dynamic MRF [7]	58.5	0.12 59	0.34 61	0.11 63	0.22 29	0.89 57	0.16 21	0.44 47	1.13 52	0.20 36	0.24 54	1.29 64	0.14 54	1.11 74	1.52 80	1.13 70	1.54 77	2.37 84	0.93 77	0.13 30	0.12 8	0.31 71	1.27 78	2.33 84	1.66 74
SegOF [10]	58.9	0.15 70	0.36 69	0.10 56	0.57 73	1.16 73	0.59 78	0.68 70	1.24 63	0.64 71	0.32 69	0.86 31	0.26 69	1.18 80	1.50 79	1.47 82	1.63 80	2.09 76	0.96 78	0.08 2	0.13 26	0.12 4	0.70 46	1.50 45	0.69 24
LDOF [28]	60.8	0.12 59	0.35 64	0.10 56	0.32 61	1.06 68	0.24 60	0.43 41	0.98 43	0.30 62	0.45 73	2.48 89	0.26 69	1.01 66	1.37 64	1.05 66	1.10 64	2.08 75	0.67 65	0.12 20	0.15 54	0.24 41	0.94 65	2.05 73	1.10 60
Ad-TV-NDC [36]	60.9	0.23 82	0.40 75	0.31 85	0.92 84	1.42 81	0.93 83	1.05 81	1.60 78	0.74 76	0.48 74	1.27 63	0.49 76	0.85 41	1.25 41	0.60 35	0.44 22	1.47 47	0.32 25	0.12 20	0.13 26	0.19 18	1.59 85	2.06 75	2.87 88
StereoFlow [44]	64.0	0.46 92	0.77 91	0.47 89	1.41 89	2.26 91	1.16 86	1.30 89	1.94 87	1.02 87	1.33 89	2.98 90	1.16 88	1.08 71	1.49 76	0.99 62	0.31 4	1.40 43	0.22 4	0.07 1	0.11 1	0.08 1	0.98 67	1.88 68	1.31 70
Shiralkar [42]	64.8	0.13 66	0.39 72	0.10 56	0.28 57	1.08 69	0.19 42	0.61 67	1.33 72	0.25 51	0.27 63	1.35 68	0.18 62	1.01 66	1.47 73	0.90 58	0.88 60	2.04 74	0.54 56	0.20 73	0.16 62	0.42 82	1.04 68	2.13 79	1.10 60
Learning Flow [11]	65.5	0.11 43	0.32 58	0.09 46	0.29 59	0.99 63	0.23 59	0.55 57	1.24 63	0.29 59	0.36 70	1.56 74	0.25 68	1.25 83	1.64 85	1.41 78	1.55 79	2.32 83	0.85 73	0.14 39	0.18 75	0.24 41	1.09 72	2.09 78	1.27 68
IAOF2 [51]	67.2	0.14 67	0.35 64	0.12 68	0.42 68	1.09 71	0.38 68	0.64 69	1.32 71	0.55 68	0.92 82	1.60 76	1.04 83	1.00 65	1.38 65	0.94 60	0.80 57	1.43 46	0.58 62	0.20 73	0.18 75	0.32 73	0.92 63	1.66 56	1.13 64
Filter Flow [19]	68.1	0.17 72	0.39 72	0.13 69	0.43 69	1.09 71	0.38 68	0.75 72	1.34 73	0.78 79	0.70 80	1.54 73	0.68 79	1.13 77	1.38 65	1.51 83	0.57 47	1.32 36	0.44 48	0.22 82	0.23 88	0.26 47	0.96 66	1.66 56	1.12 62
Modified CLG [34]	69.3	0.19 78	0.46 79	0.17 75	0.49 72	1.08 69	0.51 74	0.93 76	1.59 76	0.82 81	0.49 75	1.65 79	0.42 74	1.14 78	1.48 75	1.42 79	1.06 63	2.16 80	0.68 67	0.12 20	0.14 44	0.20 22	1.12 74	2.17 81	1.52 73
GroupFlow [9]	69.6	0.21 79	0.51 81	0.21 81	0.79 82	1.69 85	0.72 81	0.86 75	1.64 79	0.74 76	0.30 67	1.07 51	0.26 69	1.29 86	1.81 88	0.82 54	1.94 86	2.30 82	1.36 87	0.11 10	0.14 44	0.19 18	1.06 69	1.96 70	1.35 71
GraphCuts [14]	69.7	0.16 71	0.38 71	0.14 71	0.59 76	1.36 80	0.46 71	0.56 59	1.07 48	0.64 71	0.26 60	1.14 55	0.17 60	0.96 58	1.35 62	0.84 57	2.25 90	1.79 65	1.22 86	0.22 82	0.17 69	0.43 83	1.22 77	2.05 73	1.78 78
SPSA-learn [13]	70.0	0.18 76	0.45 78	0.17 75	0.57 73	1.32 78	0.51 74	0.84 74	1.50 74	0.72 74	0.52 77	1.64 78	0.49 76	1.12 76	1.42 70	1.39 77	1.75 82	2.14 78	1.06 83	0.13 30	0.13 26	0.19 18	1.32 80	2.08 77	1.73 77
IAOF [50]	70.2	0.17 72	0.39 72	0.18 77	0.61 77	1.23 75	0.55 77	1.20 85	1.87 86	0.73 75	0.66 79	1.46 71	0.72 80	0.99 63	1.36 63	0.99 62	0.73 54	1.83 66	0.45 49	0.18 70	0.15 54	0.27 53	1.30 79	1.81 63	2.09 83
Black & Anandan [4]	70.3	0.18 76	0.42 77	0.19 78	0.58 75	1.31 77	0.50 73	0.95 78	1.58 75	0.70 73	0.49 75	1.59 75	0.45 75	1.08 71	1.42 70	1.22 73	1.43 72	2.28 81	0.83 71	0.15 49	0.17 69	0.17 11	1.11 73	1.98 71	1.30 69
BlockOverlap [61]	70.8	0.17 72	0.35 64	0.16 74	0.48 71	1.02 65	0.46 71	0.75 72	1.31 70	0.59 69	0.40 72	1.47 72	0.33 73	0.96 58	1.26 45	1.14 71	1.40 71	1.47 47	0.86 74	0.31 90	0.22 85	0.86 91	1.20 76	1.78 61	2.19 84
HBpMotionGpu [43]	71.2	0.17 72	0.41 76	0.13 69	0.61 77	1.34 79	0.59 78	0.95 78	1.68 80	0.76 78	0.38 71	1.63 77	0.27 72	1.11 74	1.49 76	1.27 75	0.66 51	1.53 52	0.45 49	0.20 73	0.18 75	0.28 56	1.12 74	2.04 72	1.67 75
2D-CLG [1]	72.3	0.28 84	0.62 86	0.21 81	0.67 80	1.21 74	0.70 80	1.12 82	1.80 83	0.99 86	1.07 86	2.06 84	1.12 87	1.23 82	1.52 80	1.62 86	1.54 77	2.15 79	0.96 78	0.10 4	0.11 1	0.16 9	1.38 83	2.26 83	1.83 80
Nguyen [33]	73.2	0.22 80	0.47 80	0.19 78	0.87 83	1.29 76	0.97 84	1.17 84	1.81 84	0.92 84	0.99 84	1.82 80	1.07 84	1.17 79	1.49 76	1.46 81	0.72 53	2.09 76	0.60 63	0.14 39	0.14 44	0.20 22	1.37 81	2.18 82	1.86 81
Horn & Schunck [3]	77.0	0.22 80	0.55 82	0.22 83	0.61 77	1.53 83	0.52 76	1.01 80	1.73 81	0.80 80	0.78 81	2.02 82	0.77 81	1.26 84	1.58 83	1.55 84	1.43 72	2.59 87	1.00 81	0.16 59	0.18 75	0.15 7	1.51 84	2.50 85	1.88 82
TI-DOFE [24]	79.4	0.38 90	0.64 87	0.47 89	1.16 87	1.72 86	1.26 89	1.39 90	2.06 92	1.17 89	1.29 88	2.21 86	1.41 90	1.27 85	1.61 84	1.57 85	1.28 68	2.57 86	1.01 82	0.13 30	0.15 54	0.16 9	1.87 87	2.71 87	2.53 86
SILK [83]	79.9	0.25 83	0.55 82	0.29 84	0.77 81	1.49 82	0.79 82	1.14 83	1.83 85	0.84 82	0.59 78	1.82 80	0.55 78	1.36 87	1.69 86	1.82 88	1.92 85	2.65 88	1.15 85	0.16 59	0.13 26	0.36 77	1.69 86	2.54 86	2.30 85
Adaptive flow [45]	83.5	0.36 88	0.59 84	0.37 88	1.21 88	1.60 84	1.23 88	1.21 86	1.77 82	1.18 90	0.94 83	2.03 83	0.97 82	1.20 81	1.57 82	1.08 67	1.73 81	1.90 67	1.12 84	0.59 92	0.37 92	1.37 92	1.37 81	2.16 80	1.81 79
SLK [47]	84.6	0.30 86	0.70 88	0.36 87	1.09 86	1.77 87	1.21 87	1.25 88	1.98 89	1.03 88	1.56 91	2.26 87	1.71 91	1.54 90	1.82 89	2.14 90	2.02 87	2.79 90	1.36 87	0.17 65	0.16 62	0.26 47	2.43 89	3.18 89	3.31 90
Periodicity [82]	85.9	0.31 87	0.78 92	0.20 80	1.54 91	2.62 92	1.71 90	1.86 92	2.00 90	1.66 92	1.15 87	3.05 91	1.07 84	5.17 92	6.79 92	4.19 92	3.79 92	5.26 92	2.93 92	0.12 20	0.18 75	0.36 77	2.67 90	5.01 91	3.18 89
PGAM+LK [55]	87.1	0.37 89	0.70 88	0.59 91	1.08 85	1.89 89	1.15 85	0.94 77	1.59 76	0.88 83	1.40 90	3.28 92	1.33 89	1.37 88	1.70 87	1.67 87	2.10 88	2.53 85	1.39 89	0.36 91	0.28 91	0.65 88	1.89 88	2.72 88	2.71 87
FOLKI [16]	88.3	0.29 85	0.73 90	0.33 86	1.52 90	1.96 90	1.80 91	1.23 87	2.04 91	0.95 85	0.99 84	2.20 85	1.08 86	1.53 89	1.85 90	2.07 89	2.14 89	3.23 91	1.60 90	0.26 88	0.21 84	0.68 89	2.67 90	3.27 90	4.32 91
Pyramid LK [2]	90.4	0.39 91	0.61 85	0.61 92	1.67 92	1.78 88	2.00 92	1.50 91	1.97 88	1.38 91	1.57 92	2.39 88	1.78 92	2.94 91	3.72 91	2.98 91	3.33 91	2.74 89	2.43 91	0.30 89	0.24 89	0.73 90	3.80 92	5.08 92	4.88 92

Move the mouse over the numbers in the table to see the corresponding images. Click to compare with the ground truth.

Figure 4: Average endpoint error (EPE) ranking on Middlebury benchmark (captured on *Oct 30th, 2013*). The ranking is for our algorithm without hierarchical matching (only one record for each publication is allowed on this benchmark).

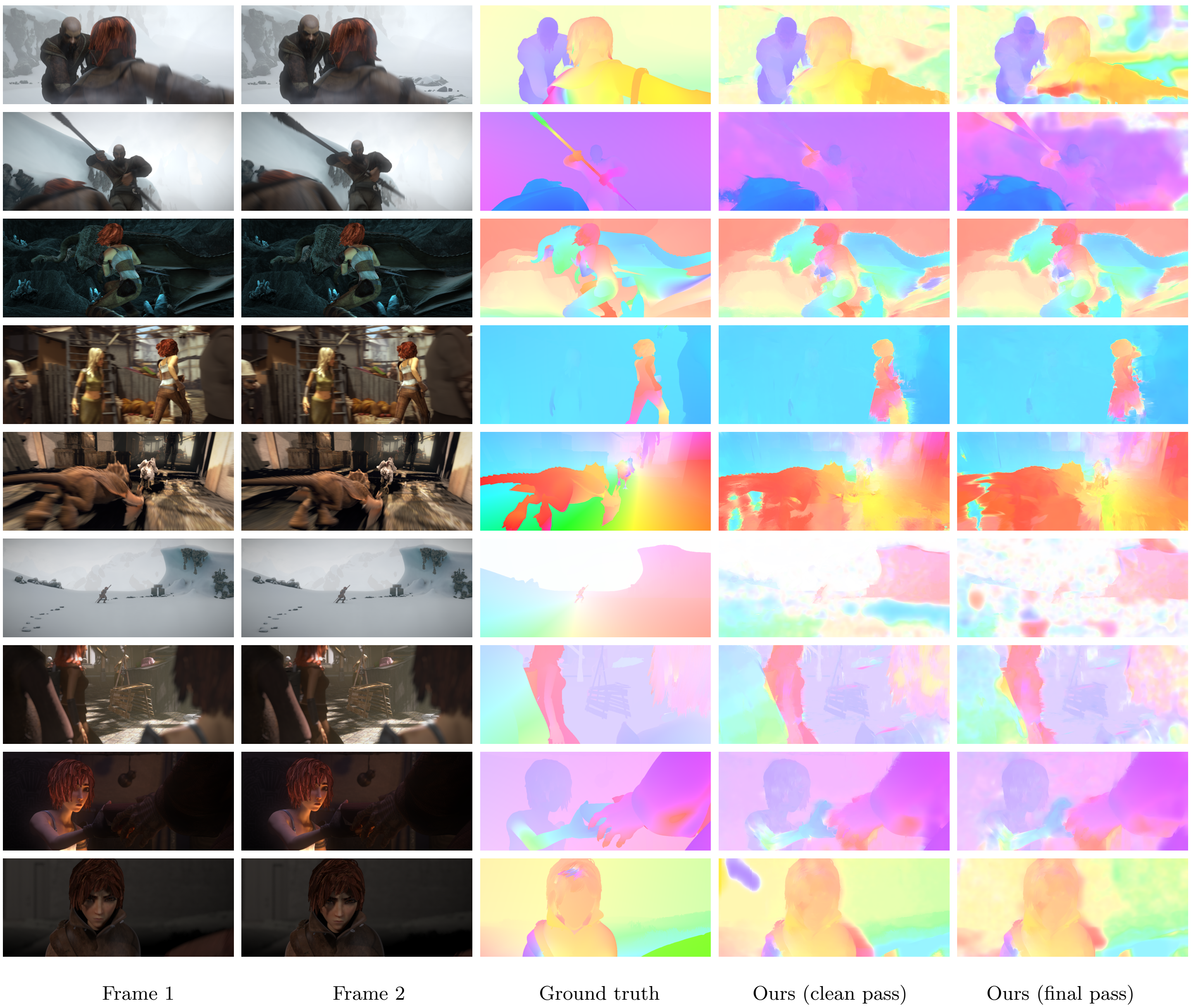
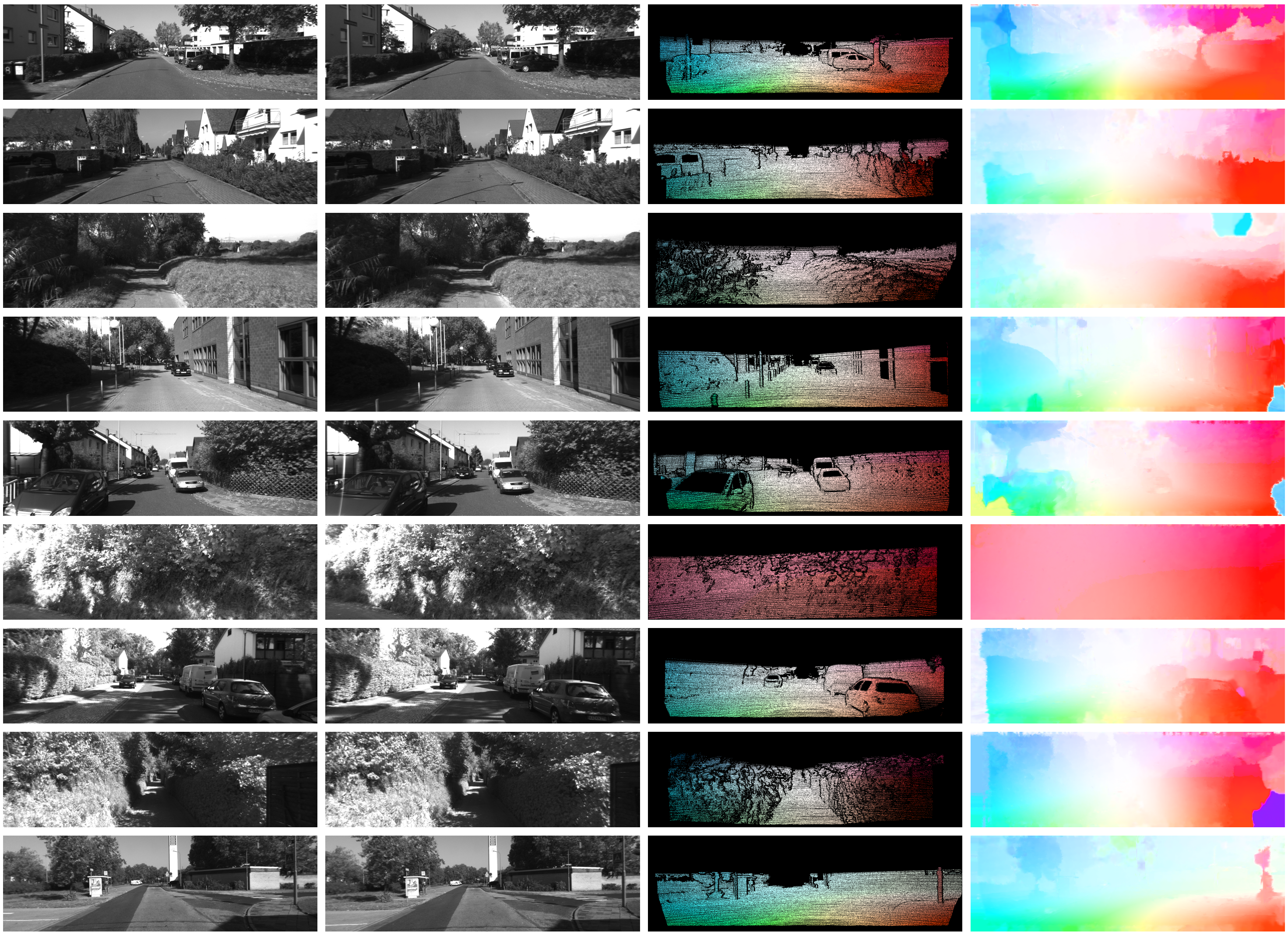


Figure 5: Our results on MPI Sintel benchmark.



Frame 1 | Frame 2 | Ground truth | Ours result

Figure 6: Our results on KITTI benchmark (with MPI Sintel color coding for visual show).