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Occluded Bilateral EPI Regularization

2nd Workshop on Light Fields for Computer Vision

July 26, 2017

Overview

- standard minimization approach
  $\rightarrow$ data term, smoothness term, solver
- some twists for crisper and smoother results
- some (over) simplifications

3D Reconstruction as Minimization Problem

- inverse problem
- underconstrained
- non-convex

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Key Insights

The Problem is inherently non-differentiable due to occlusions

$\rightarrow$ enforcing differentiabiliy will result in sub-optimal results

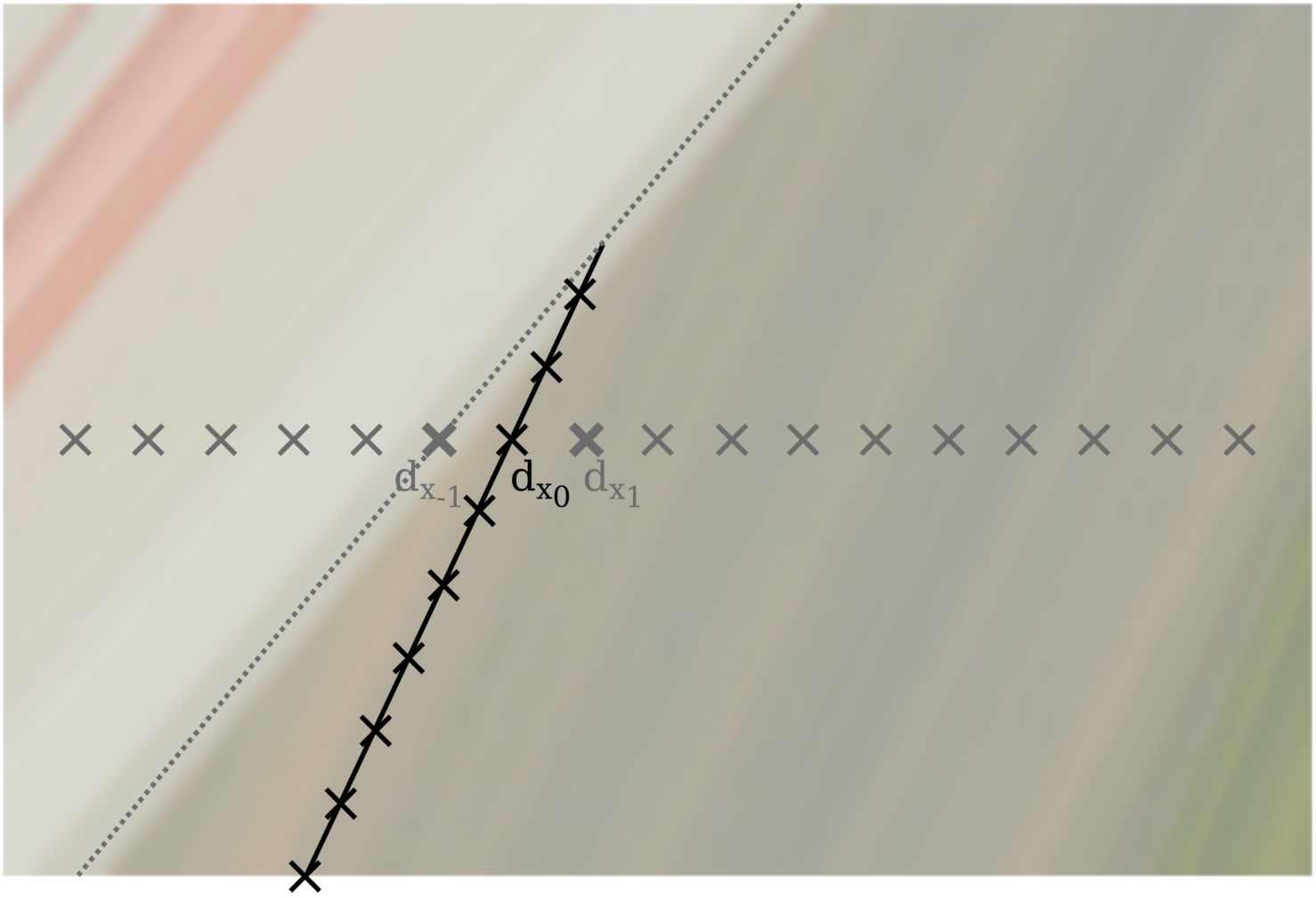
Secondary

Intermediate steps impair occlusion border & fine detail performance

$\rightarrow$ formulate error metrics in input domain

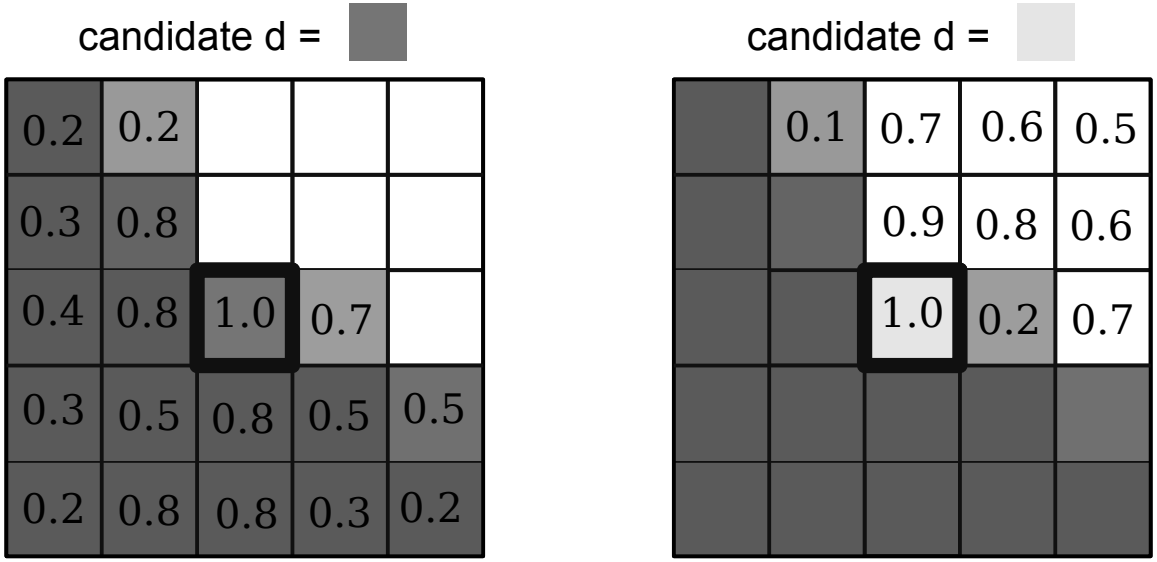
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Data Term



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Smoothness Term



- modified bilateral filter
- evaluate both color and disparity
- hard thresholds $\rightarrow$ crisp occlusion boundaries

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Solver

Algorithm 1 Randomized Solver

```
1: for 20 iterations do
2:     for Every disp map pixel do
3:         Calc error for current depth
4:         Calc error for depth candidates
5:         Keep best result
6:     end for
7: end for
```

Depth Candidates

- random change
- random guess
- random (large range) neighbour
- direct neighbour

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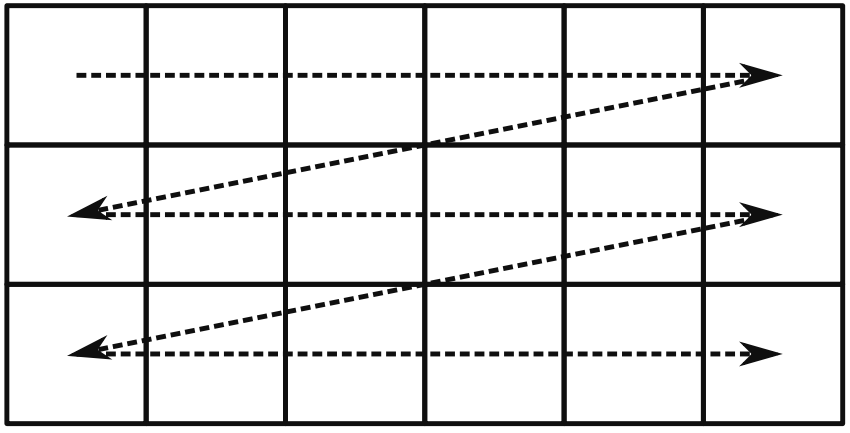
Propagation

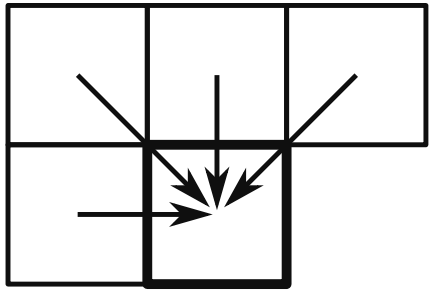
pixel processing order

neighbour candidates

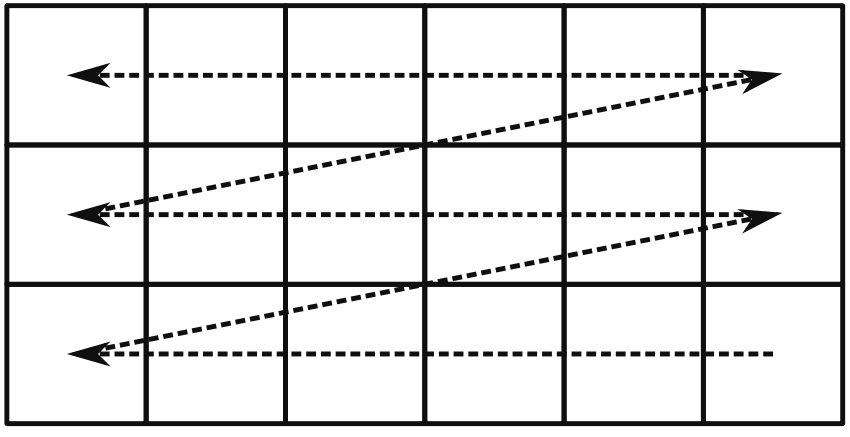
iteration

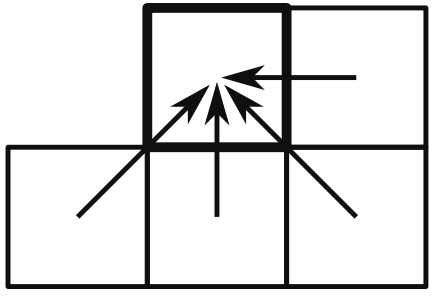
even



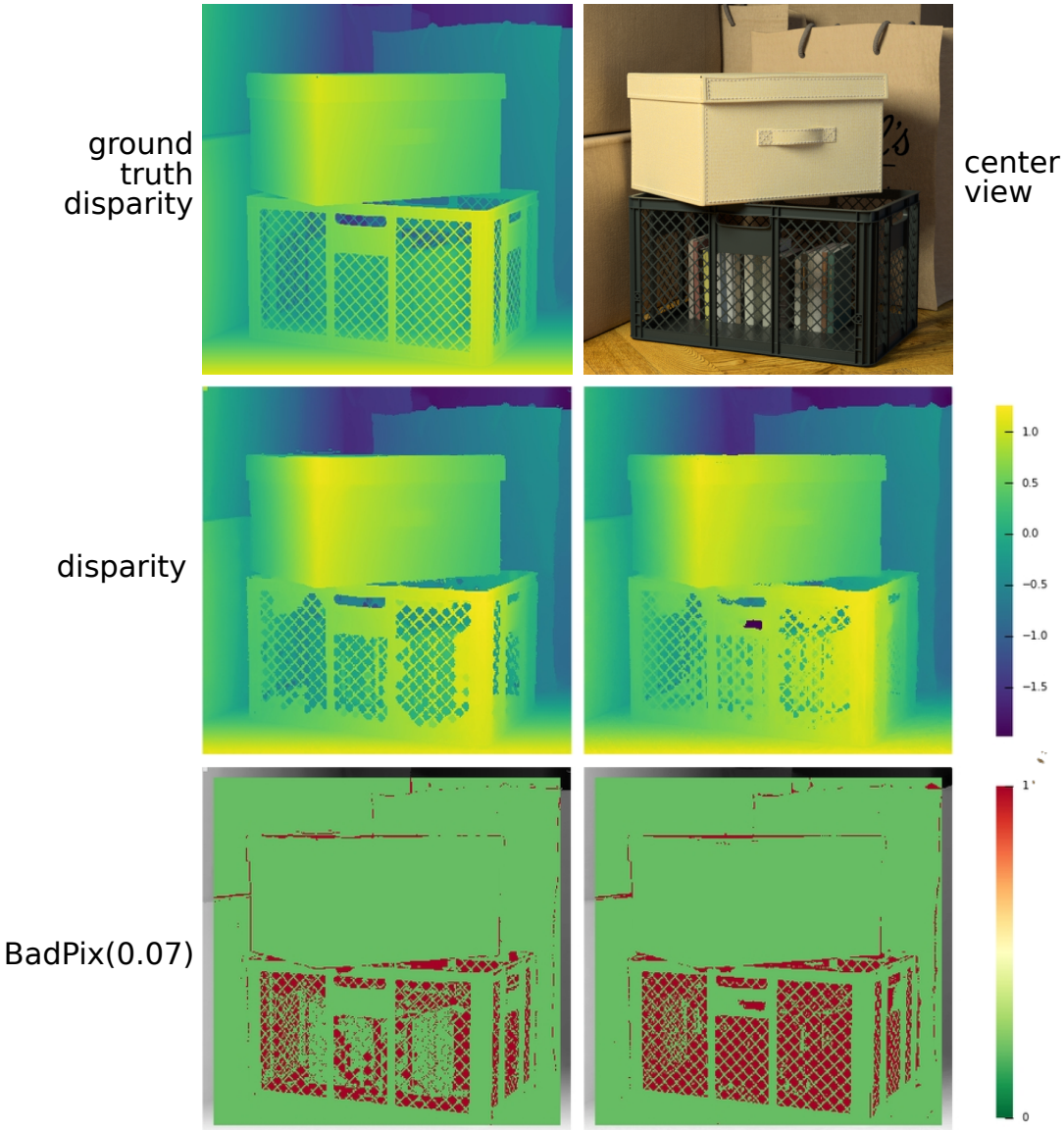


odd





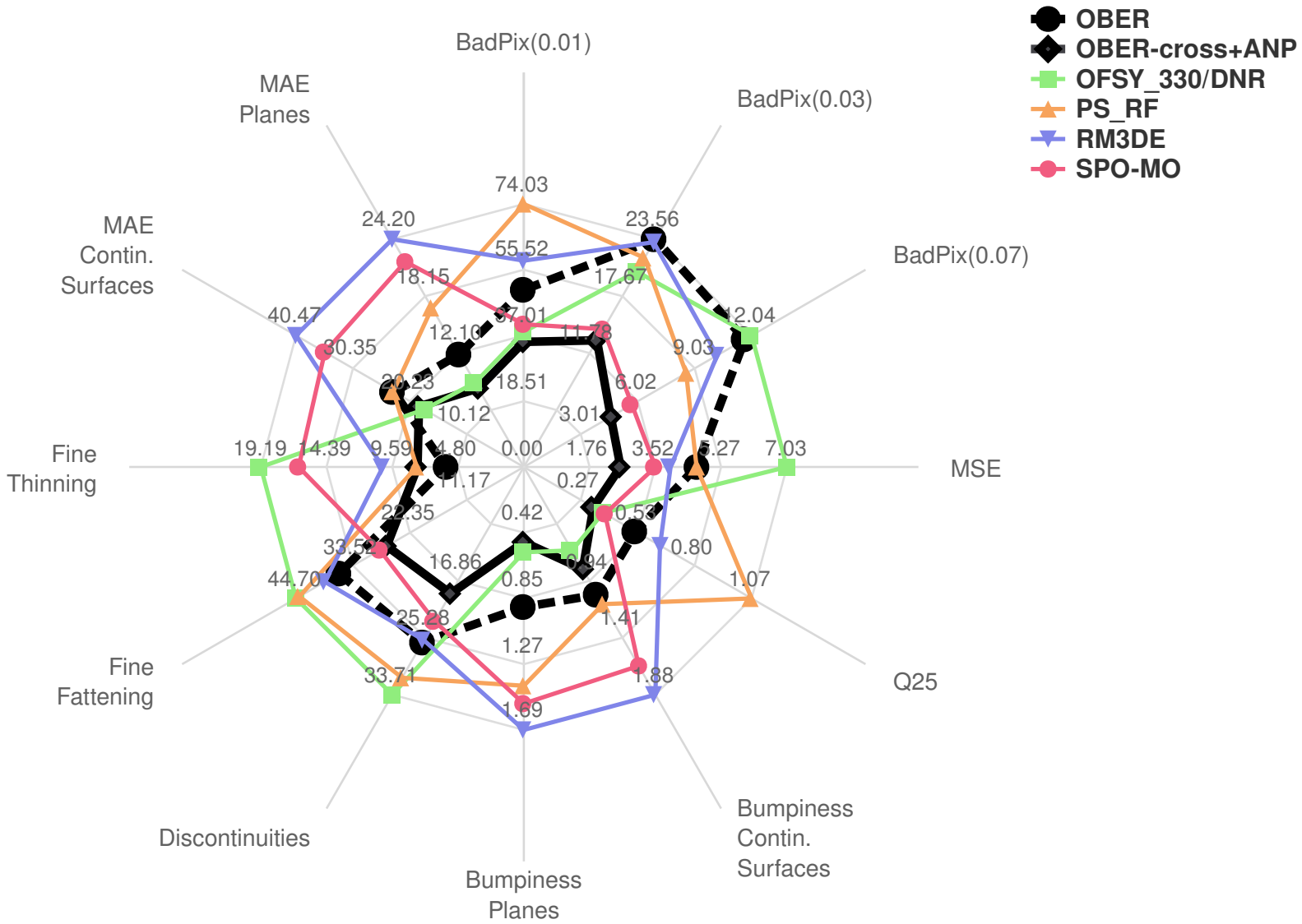
Results



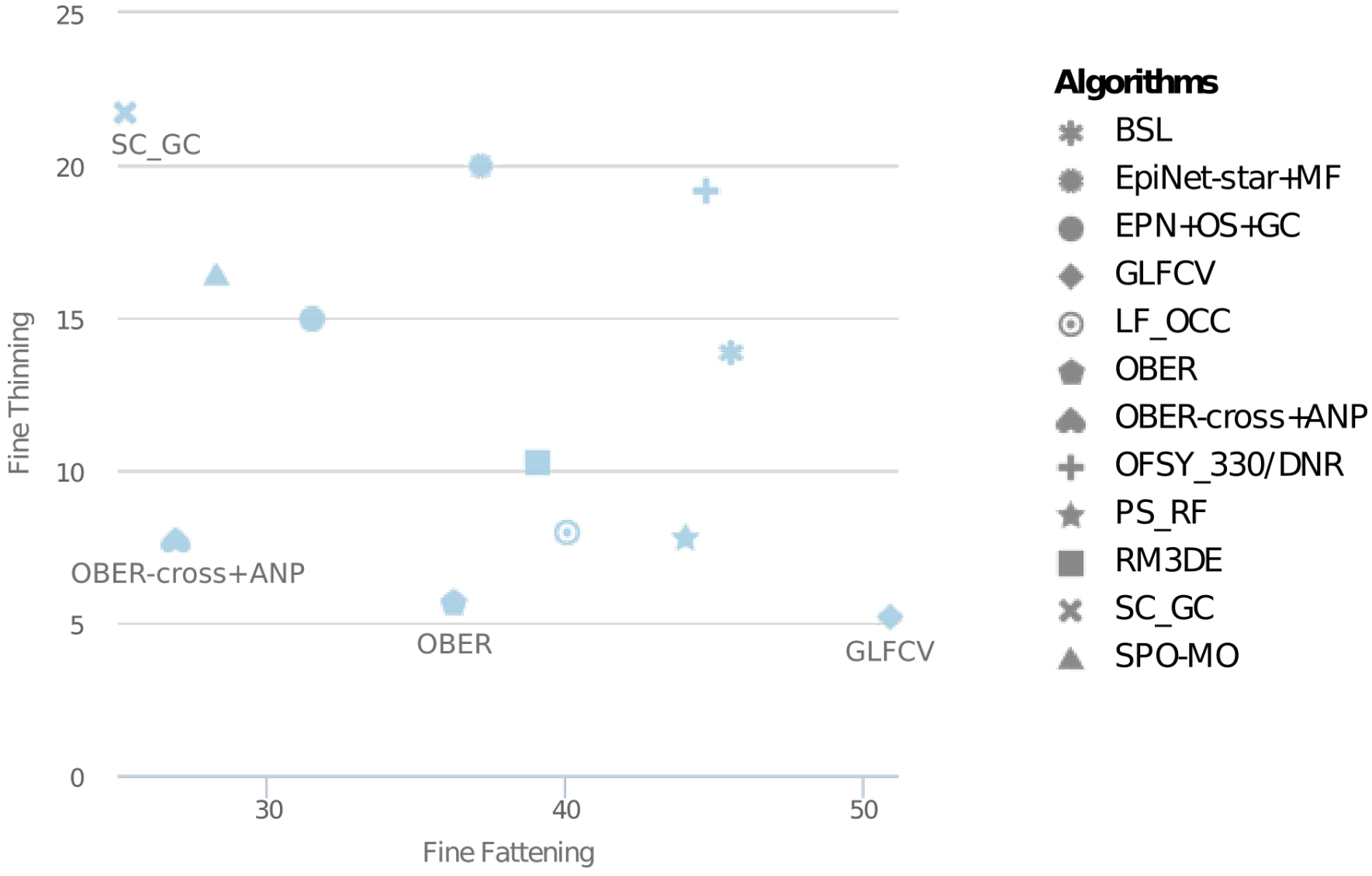


mesh of OBER result
(as viewed from above)

Results

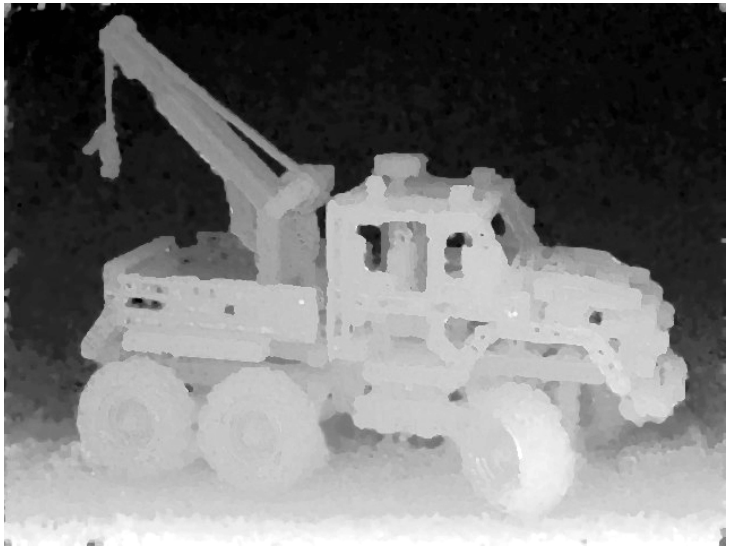

OBER
OBER-cross+ANP
OFSY_330/DNR
PS_RF
RM3DE
SPO-MO
BadPix(0.01)
BadPix(0.03)
BadPix(0.07)
MSE
Q25
Bumpiness Contin. Surfaces
Bumpiness Planes
Discontinuities
Fine Fattening
Fine Thinning
MAE Contin. Surfaces
MAE Planes
74.03
55.52
18.51
10.12
0.00
23.56
17.67
12.04
7.03
3.52
1.76
0.27
0.42
0.85
1.27
1.41
1.07
0.80
1.88
1.69
33.71
25.28
16.86
11.17
22.35
33.50
44.70
19.19
14.39
9.59
4.80
40.47
30.35
24.20
18.15
12.16
9.03
6.02
3.01
0.53
0.94
24.20
18.15
12.16
9.03
6.02
3.01
0.53
0.94

Results

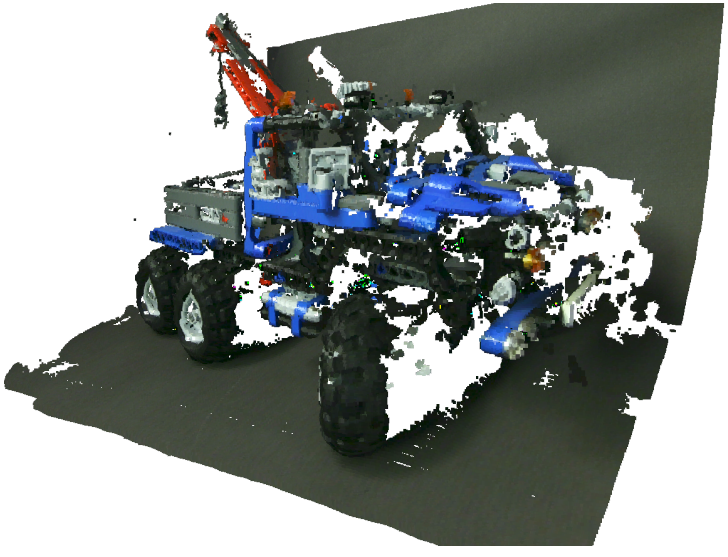

25
20
15
10
5
0
Fine Thinning
SC_GC
OBER-cross+ANP
OBER
GLFCV
30
40
50
Fine Fattening
Algorithms
BSL
EpiNet-star+MF
EPN+OS+GC
GLFCV
LF_OCC
OBER
OBER-cross+ANP
OFSY_330/DNR
PS_RF
RM3DE
SC_GC
SPO-MO

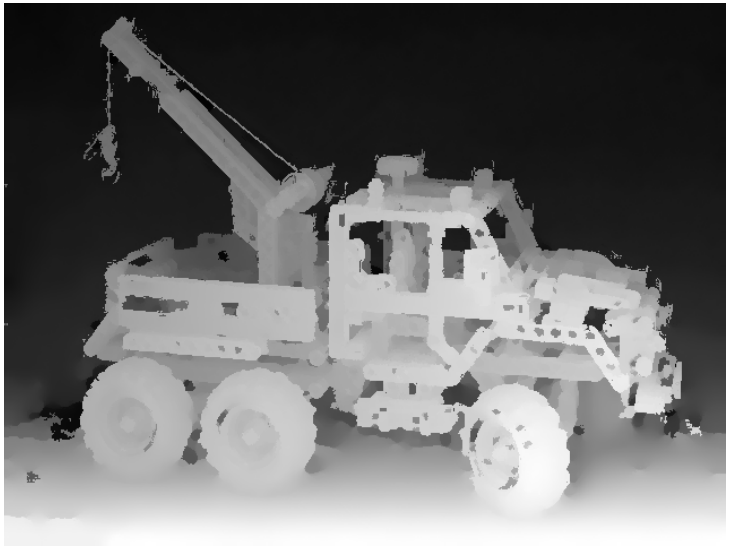
Results





reference result
(OFSY_330/DNR)





OBER-cross+ANP
(half-size imgs)

Outlook

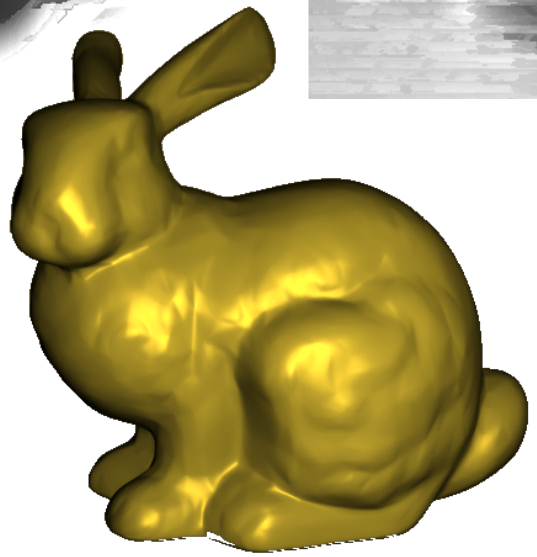
A lot of things to improve:
scale space, un-occlusions, heuristics $\rightarrow$ NN, disp map $\rightarrow$ mesh

Main strength:
very flexible, per-pixel adaptable solver

Outlook







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The End