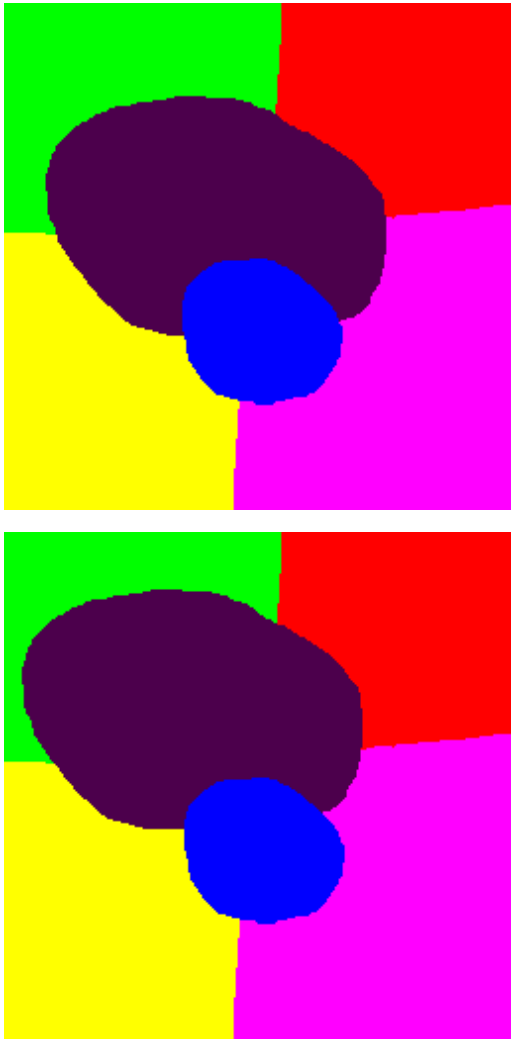
relative depth from monocular optical flow

26–10–2010

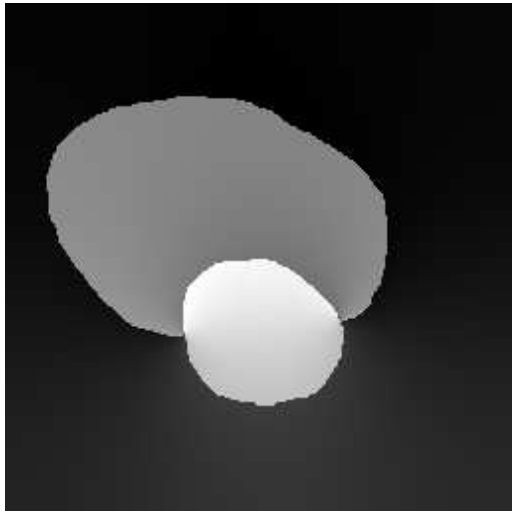
Overview

input (two frames)



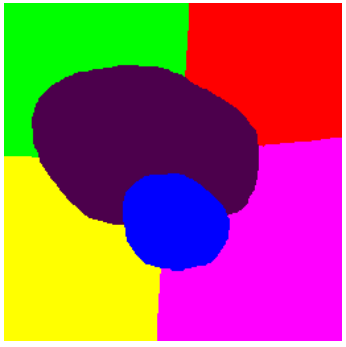
$\Rightarrow$

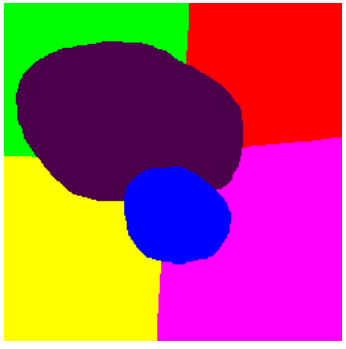
output (relative depth map)



Steps

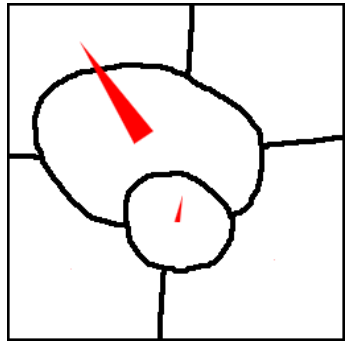
input





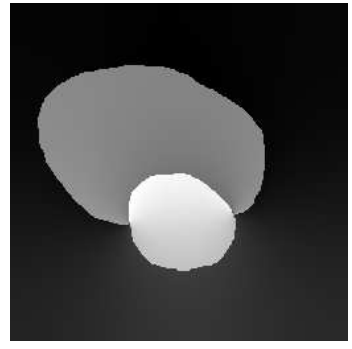
$\Rightarrow$

segmented flow & occlusions



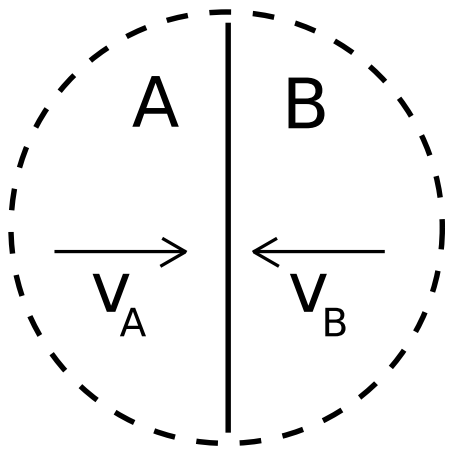
$\Rightarrow$

output

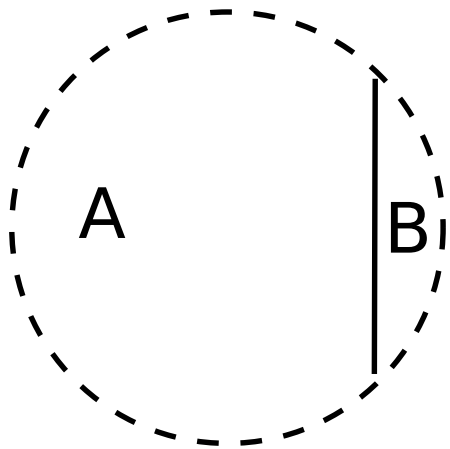


Basic Principle

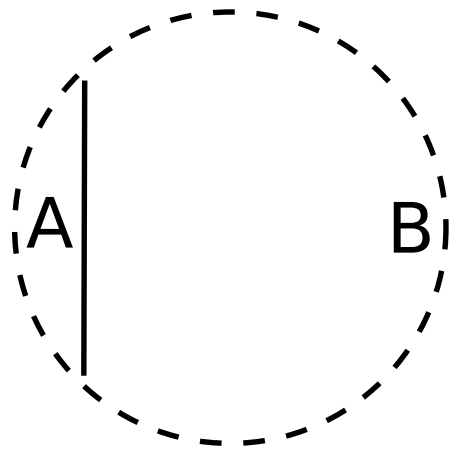
"The boundary between two regions follows the region which is closer to the camera."



frame $t = 0$



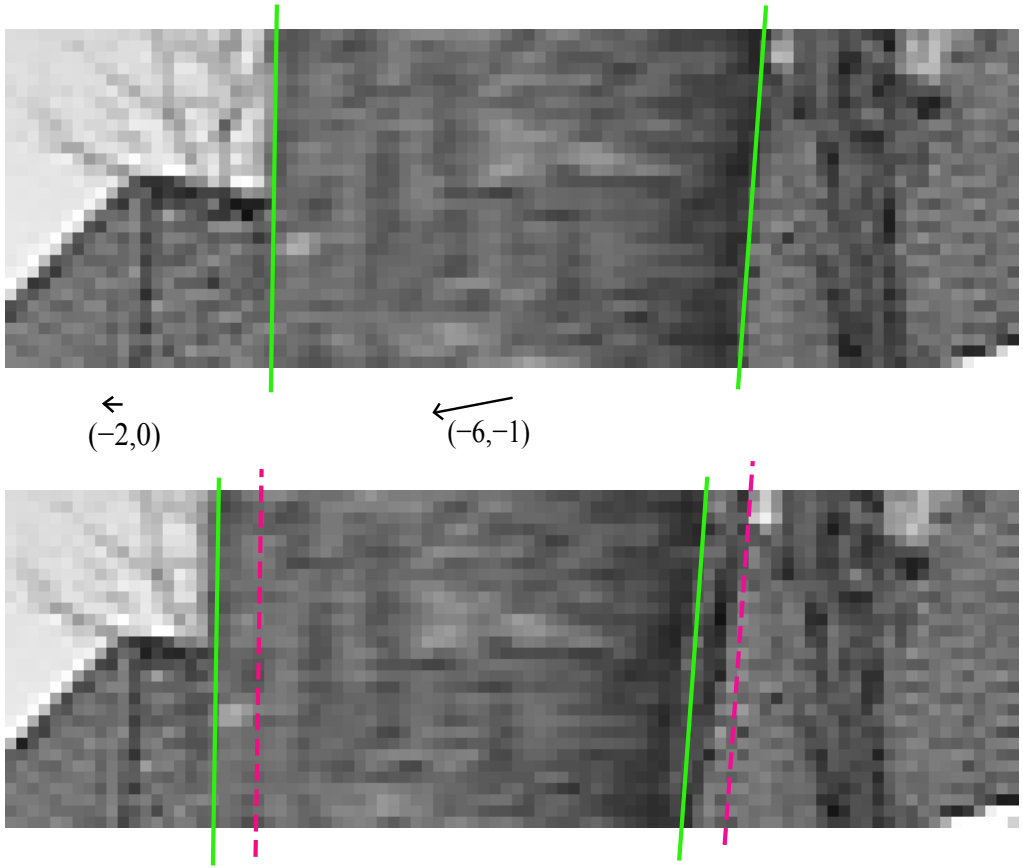
frame $t = 1$
(if *A* above *B*)



frame $t = 1$
(if *A* below *B*)

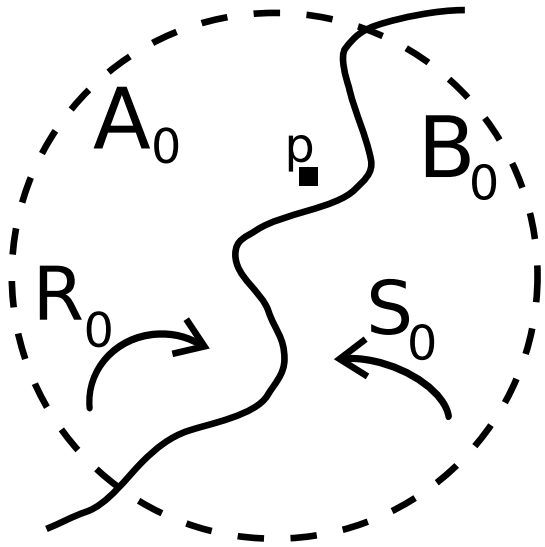
Basic Principle

"The boundary between two regions follows the region which is closer to the camera."

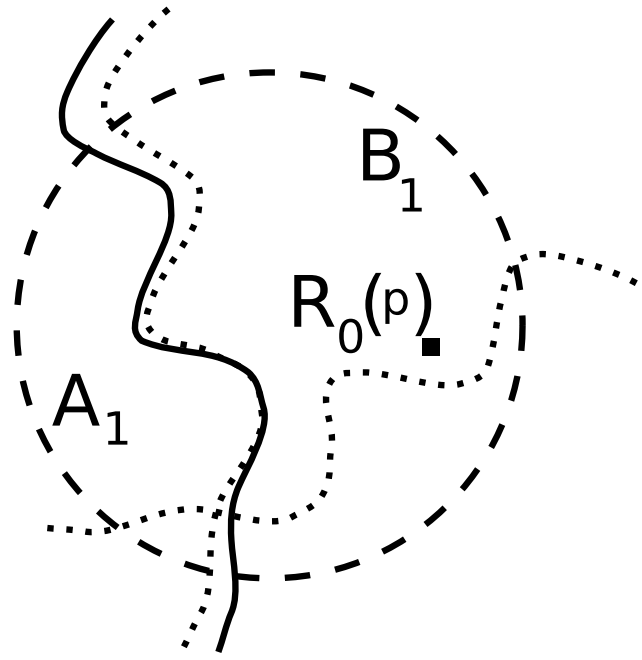


Implementation

Each occluded pixel *votes* for a relative depth order

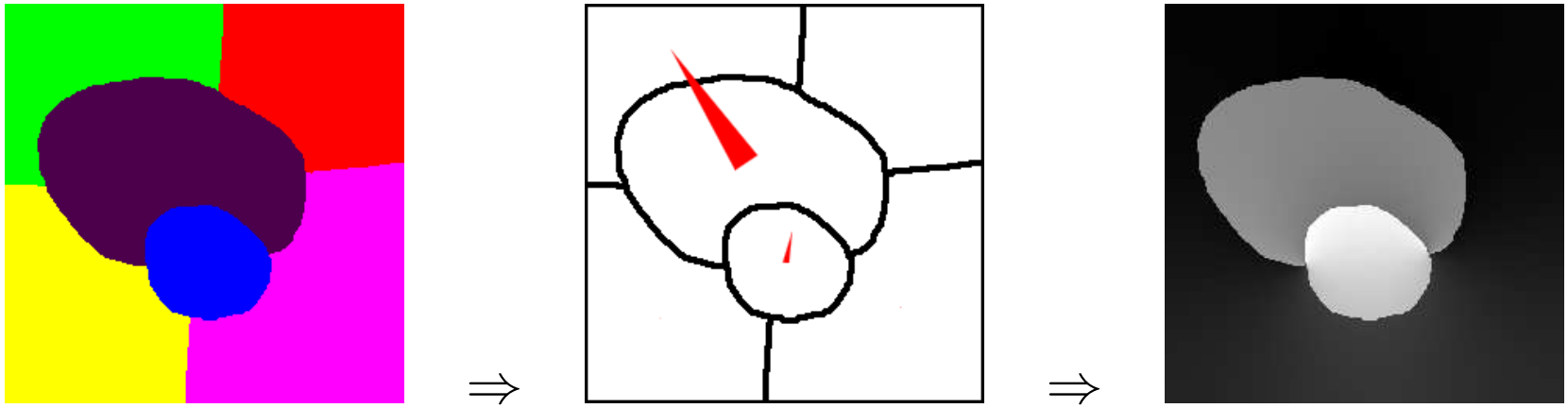


$t = 0$

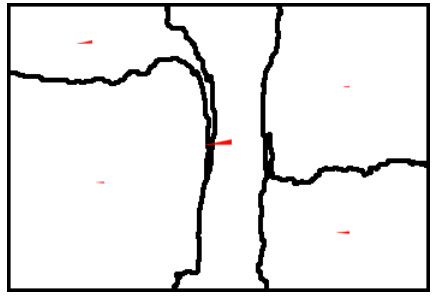
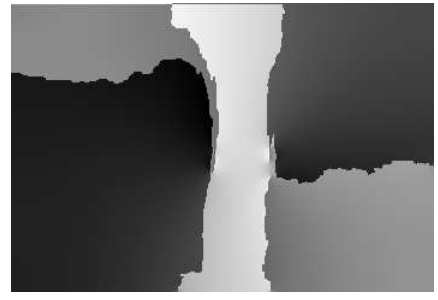


$t = 1$

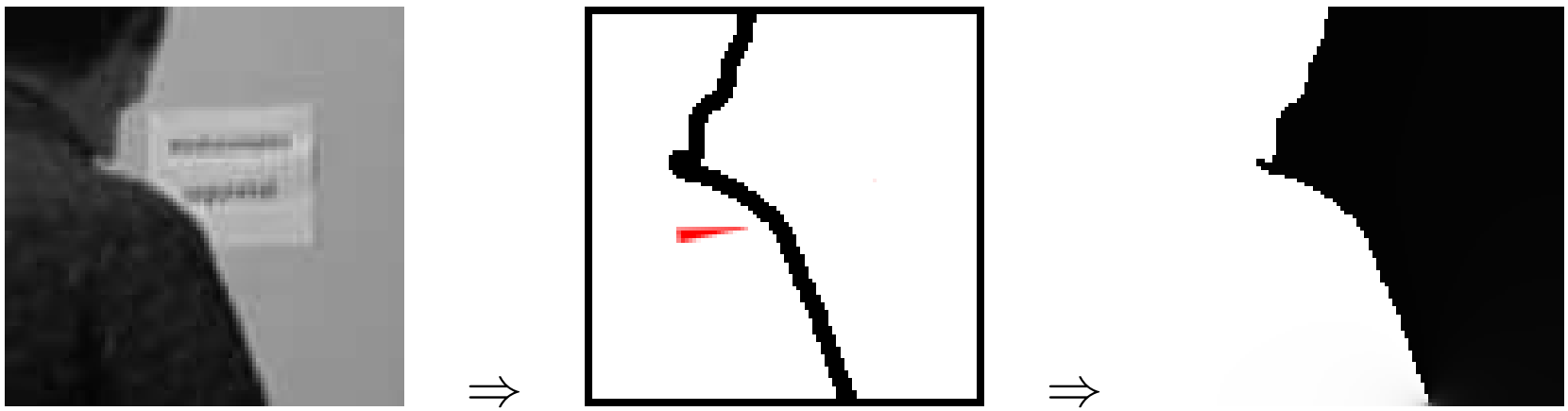
Results



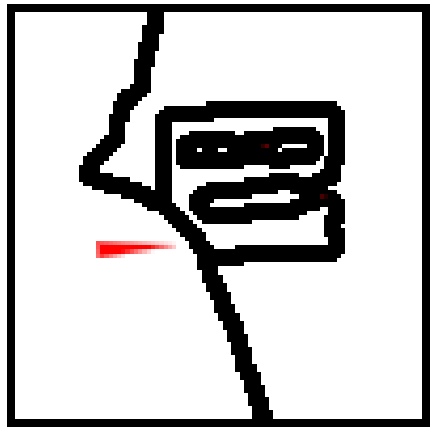
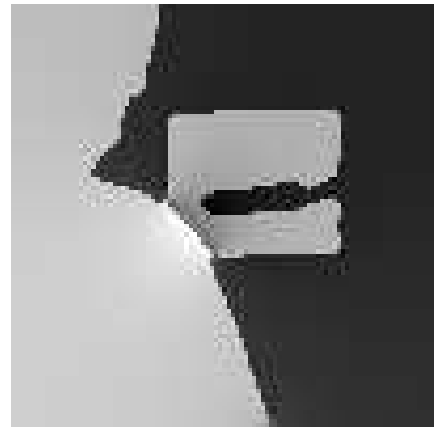
Results

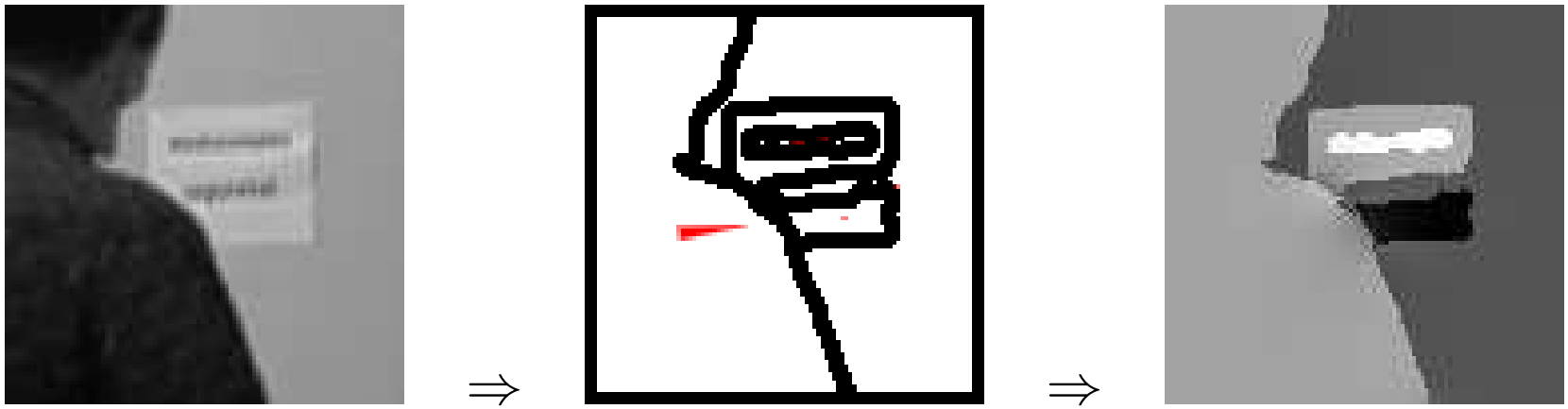
Results



Results

Results



Results



Results: input frame 4

Results: input frame 5

Results: input frame 6

Results: input frame 7

Results: input frame 8

Results: input frame 9

Results: input frame 10

Results: input frame 11

Results: input frame 12

Results: input frame 13

Results: input frame 14

Results: input frame 15

Results: input frame 16

Results: input frame 17

Results: input frame 18

Results: input frame 19

L

Results: raw output 4

Results: raw output 5

Results: raw output 6

Results: raw output 7

Results: raw output 8

Results: raw output 9

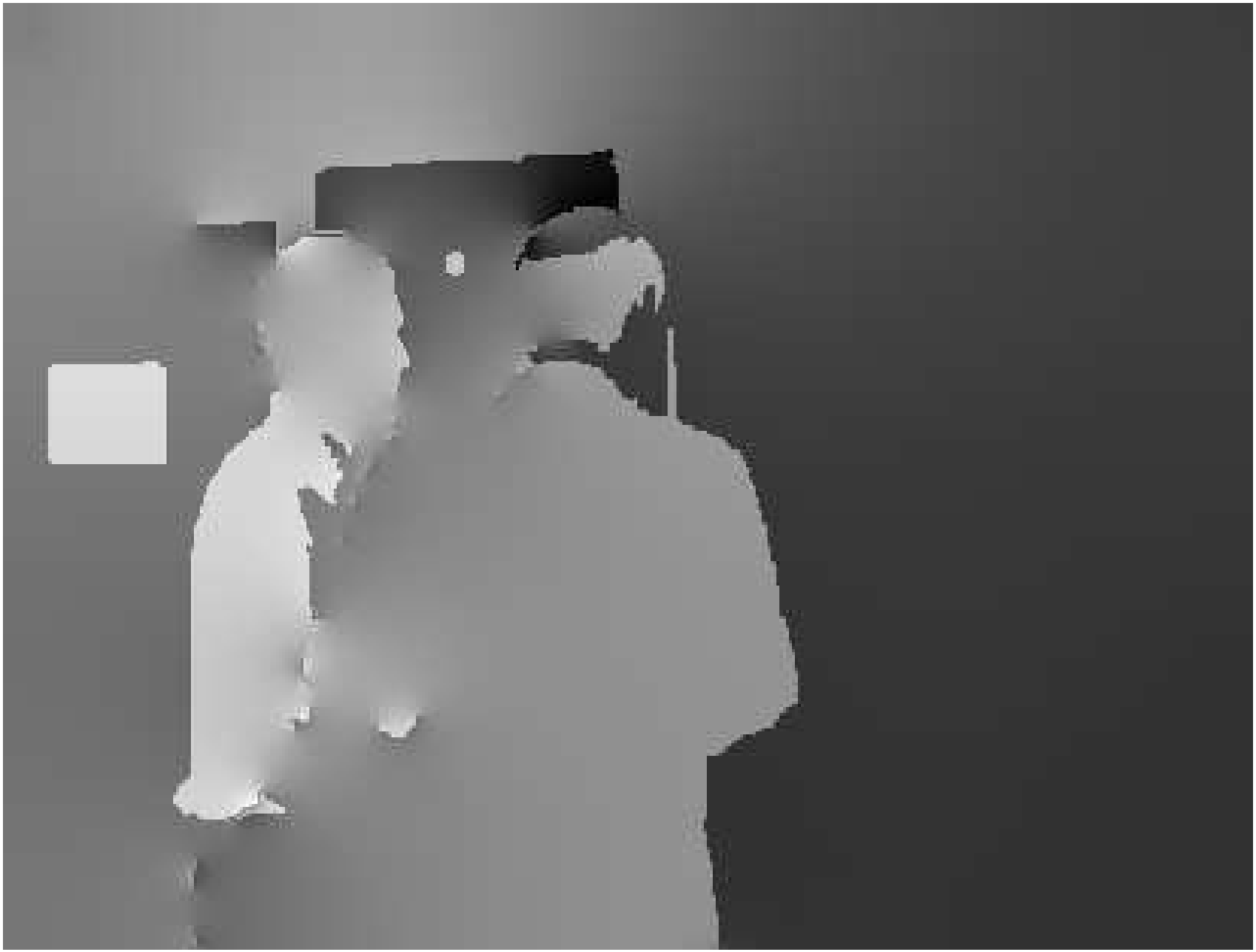
Results: raw output 10

Results: raw output 11

Results: raw output 12

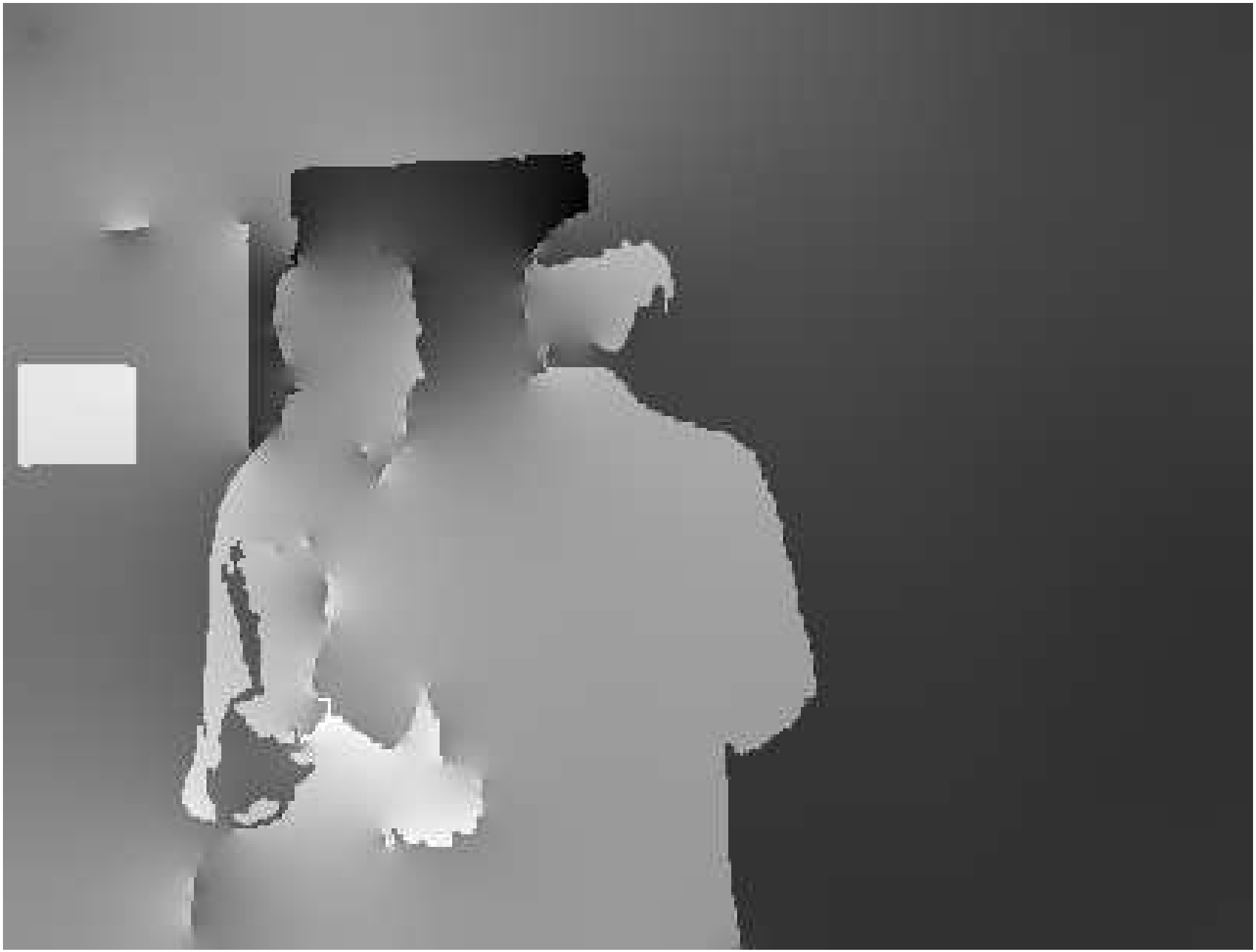
Results: raw output 13

Results: uncluttered output 4

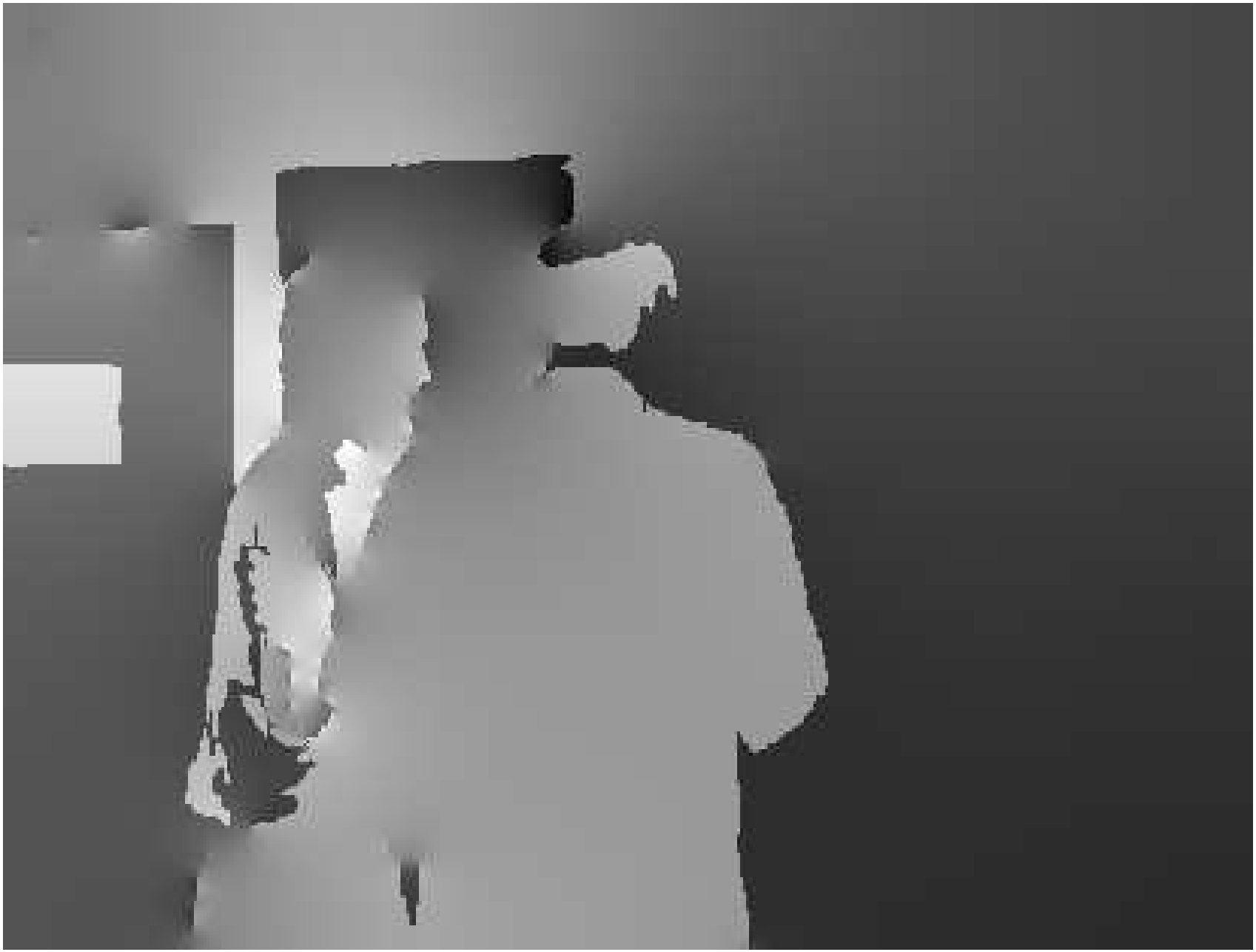


Results: uncluttered output 5

Results: uncluttered output 6



Results: uncluttered output 7



Results: uncluttered output 8

Results: uncluttered output 9

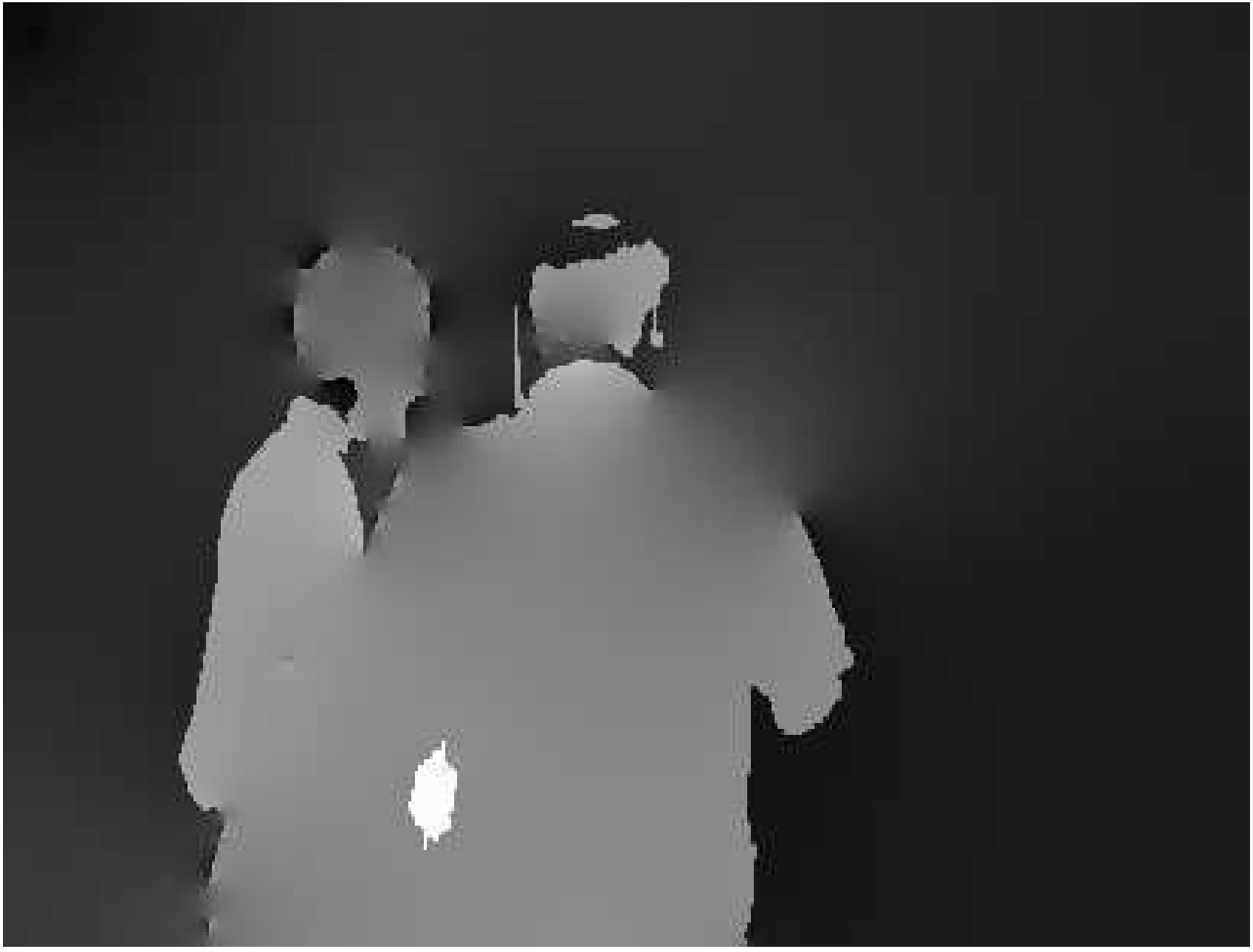
Results: uncluttered output 10

Results: uncluttered output 11

Results: uncluttered output 12

Results: uncluttered output 13

Results: uncluttered output 14



Results: uncluttered output 15

L

Application

Boundary conditions for video inpainting.

Technicalities: choice of optical flow

The method works using an *arbitrary* pre-computed *optical flow*. Several choices:

- Sparse + interpolated. (sift, curve matching)
- Dense (Brox-Warp, Brox-LDOF, Garrido, Alvarez, Papadakis, Lucas-Kanade)
- Segmentation-based

Technicalities: choice of segmentation

The method works using an *arbitrary segmentation* of the video into tubes. Several choices:

- level-lines based
  - blind quantization
  - adaptive global quantization
  - local adaptive (MSER, MLL)
- mumford-shah based
  - gray, color
  - flow
  - combined
- post-processing
  - grain filtering
  - mean filtering
  - modal filtering

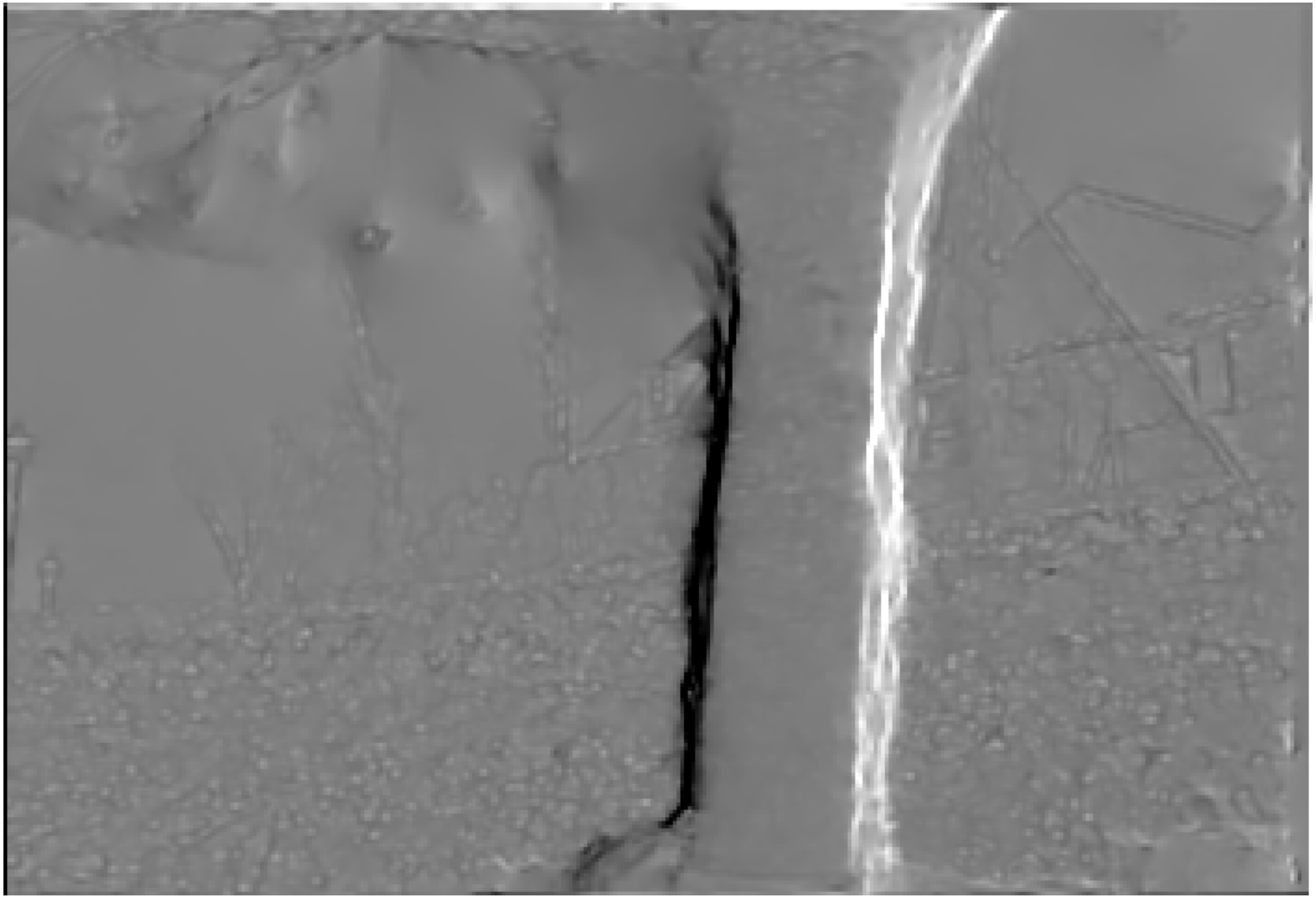
Technicalities: motion models

We build a model for the movement of each region. Several choices:

- mean traslation
- “median” traslation ✔
- affine fitting (Least Squares)
- affine fitting (RANSAC)
- homographies

Technicalities: heuristics

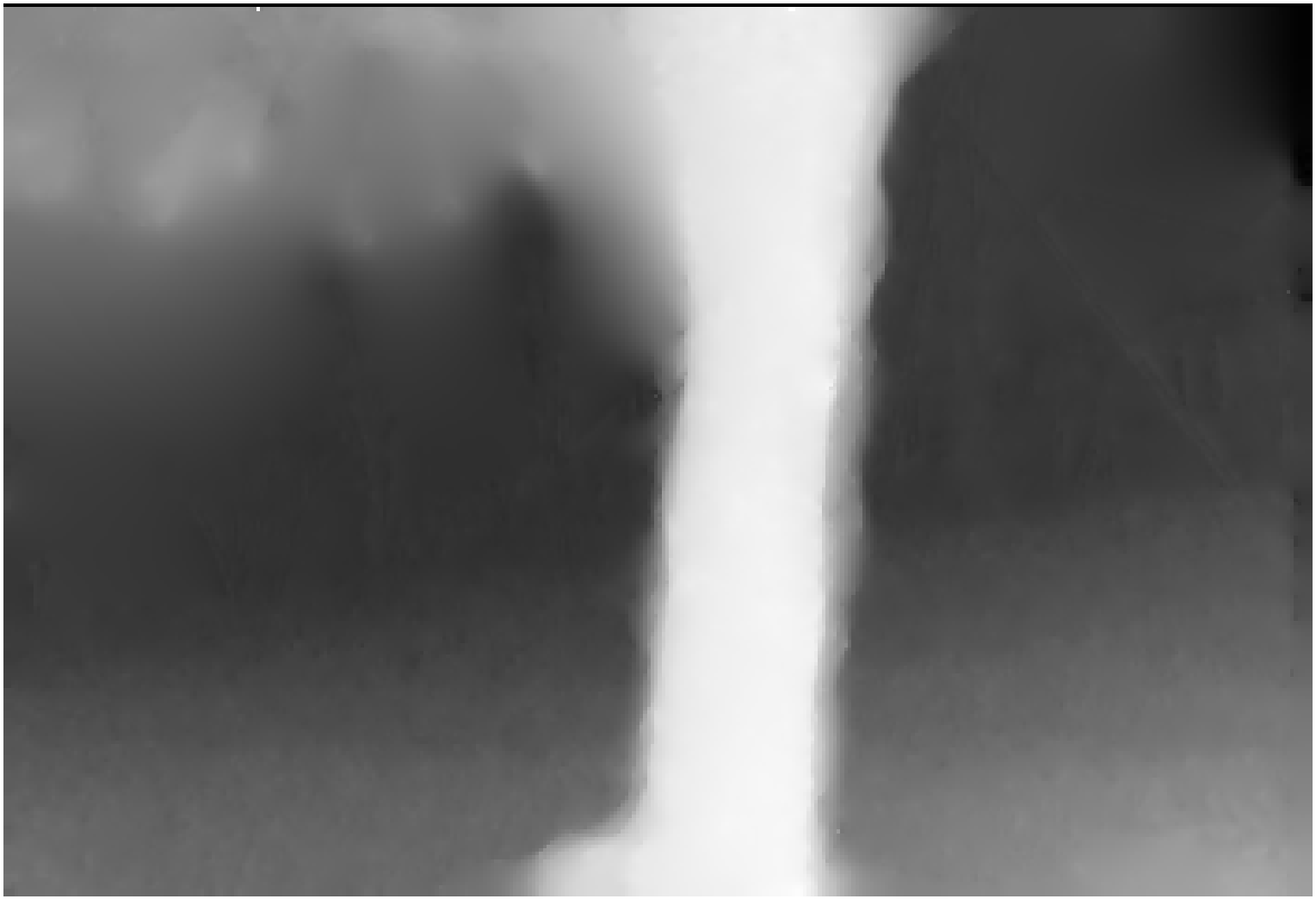
The *optical flow divergence* has spikes near occlusions



flow divergence

Technicalities: heuristics

Close objects tend to move faster.



flow norm

Future work

- make the appropriate coices
- improve uncluttering
- TEMPORAL INTEGRATION (work on pairs of neighboring moving regions) ((e.g.: tube-based voting!))