EE 584: Machine Vision
2015-2016 Term Project

StereoSnakes: Contour Based Consistent Object Extraction For Stereo Images

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Article Information

StereoSnakes: Contour Based Consistent Object Extraction For Stereo Images

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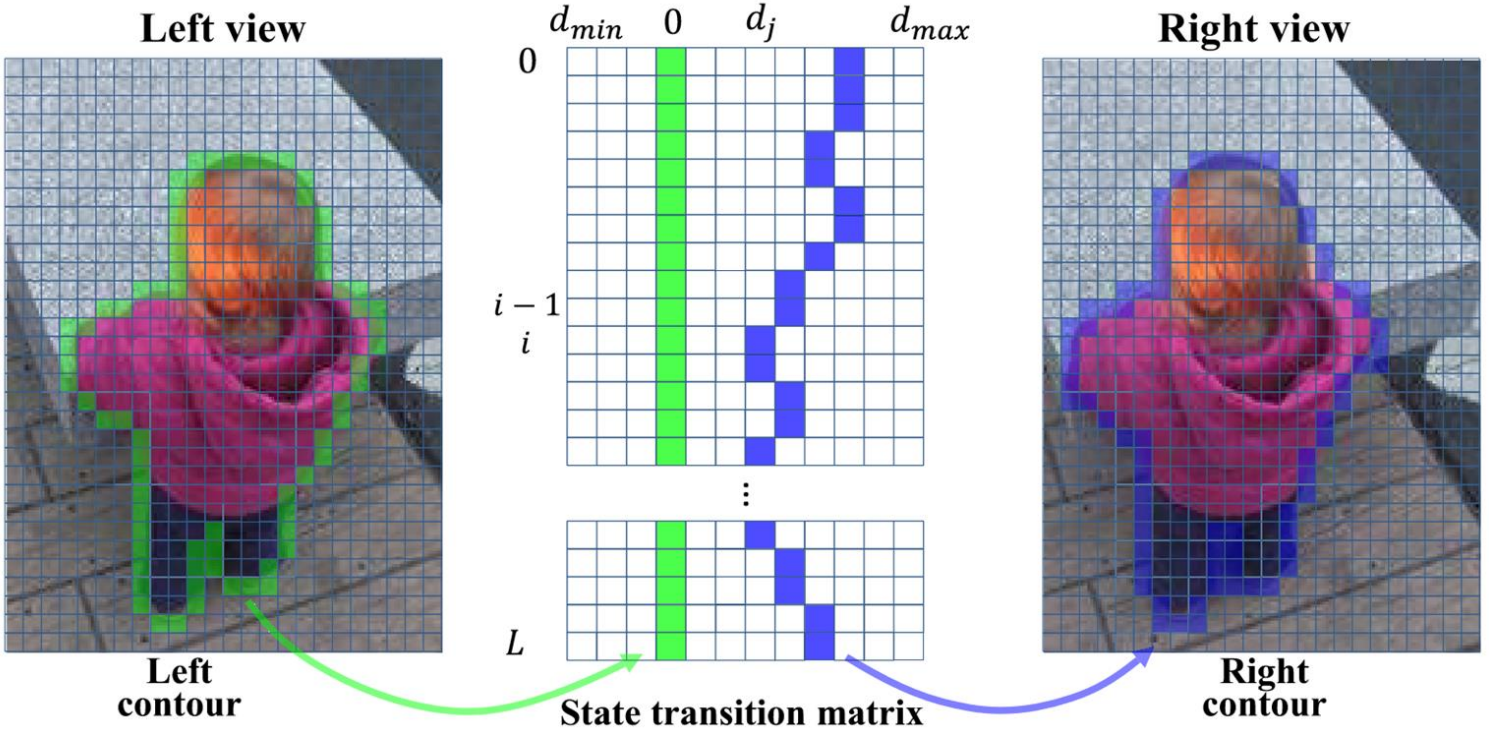
- Problem and Solution
- Applications



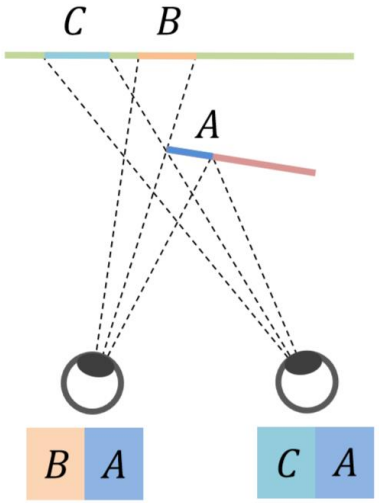
Main Energy Equation

- Left / right image -> segmentation -> mask -> contour !
- Snake energy equation

$$E(d) = \sum_{p_i \in \mathcal{C}_m} C_S(p_i, p_i - d(p_i)) + \lambda_o C_O(p_i, p_i - d(p_i)) + \lambda_s N(p_i, p_{i-1})$$

Stereo Correspondence Cost (Cs)

- Background Occlusion



$$C_{AD}(p_i, p_j) = \sum_{h=\{R,G,B\}} |c_h(p_i) - c_h(p_j)|$$

$$C_S(p_i, p_j) = \sum_{p_x \in \Phi(p_i) \wedge K(p_x)=1} C_{AD}(p_x, p_y)$$


di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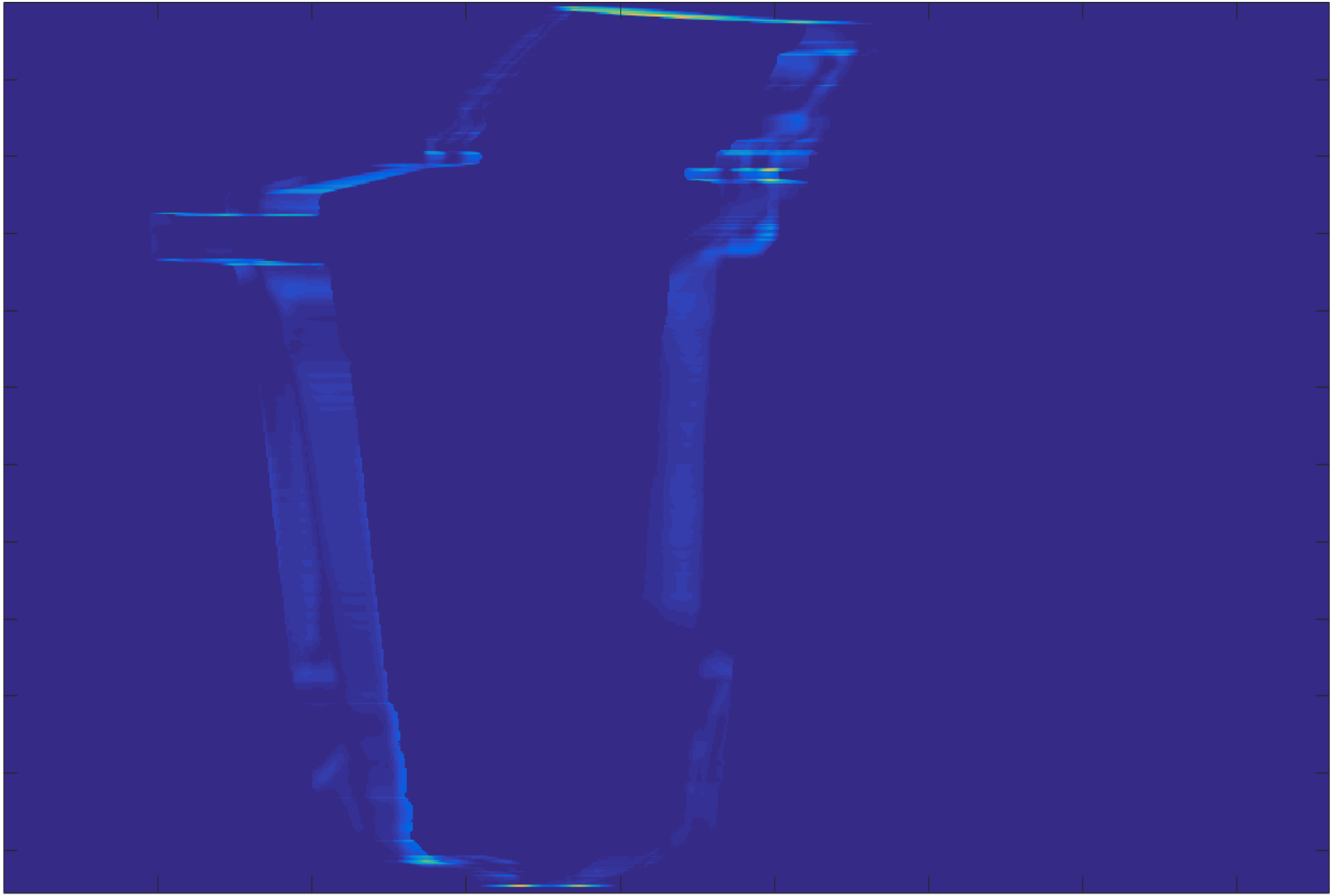
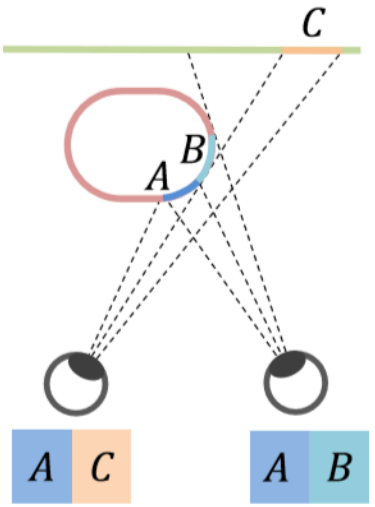


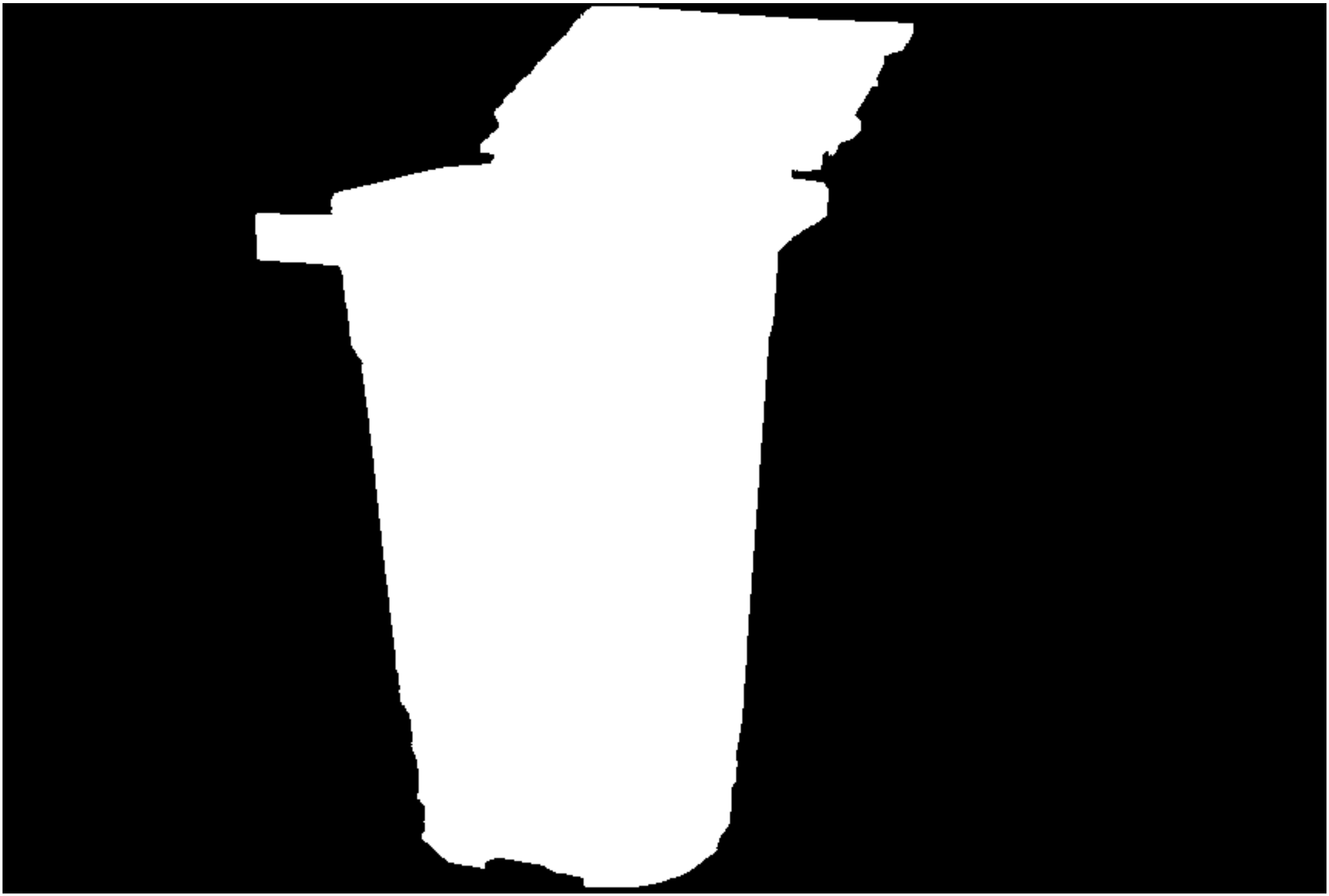
Object Boundary Cost (Co)

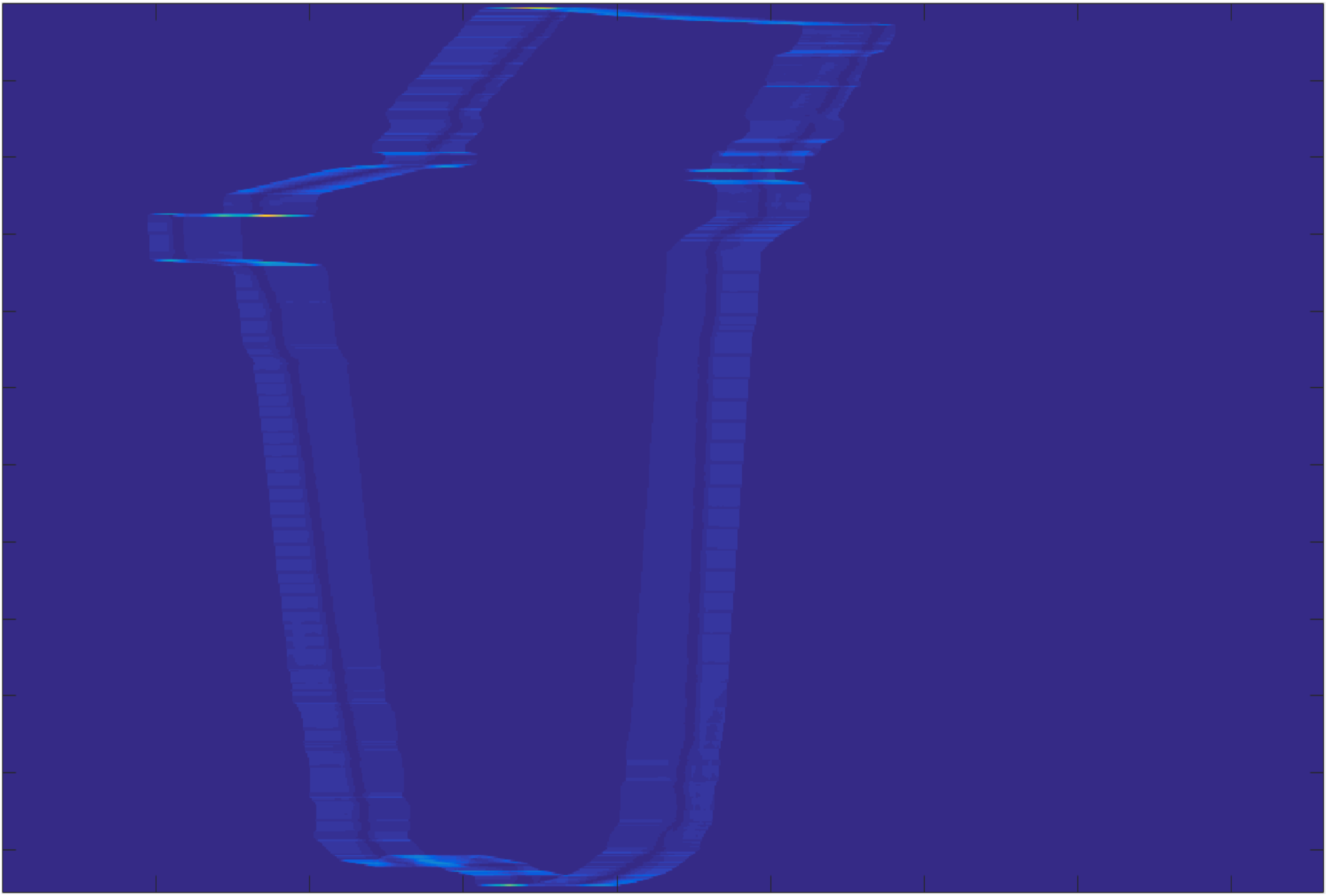
- Self-Occlusion



$$C_O(p_i, p_j) = \sum_{p_x \in \Phi(p_i)} |Pr(O|p_y) - K(p_x)|$$

$$Pr(O|p_y) = \frac{H_O(c(p_y))}{H_O(c(p_y)) + H_B(c(p_y))}$$





Dynamic Optimization (N)

$$N(p_i, p_{i-1}) = \begin{cases} C_p, & \text{if} \quad |d(p_i) - d(p_{i-1})| \leq \tau_d \\ \infty, & \text{otherwise} \end{cases}$$

- State Function

$$E_{stf}(i,j) = \begin{cases} E(p_i, d_j), & i = 1 \\ E(p_i, d_j) + \min\limits_{t \in [j-\tau_d, j+\tau_d]} E_{stf}(i-1, t), & otherwise \end{cases}$$

Algorithm Overview

- Complexity O(LD)
- Selection of contour start point matters
- This simple pseudo-code assumes τ = 1.

Algorithm 1 Contour Correspondence

Input: $\mathcal{C} = \{p_1, p_2, ..., p_L\}$
Output: $\mathcal{C}' = \{p_1', p_2', ..., p_L'\}$

1: // State transition matrix calculation
2: **for** each cell (i, j) in $M_{L \times D}$ **do**
3: $M_{i,j} = E(p_i, d_j)$
4: **end for**
5: **for** $i = 2$ to L **do**
6: **for** $j = 1$ to D **do**
7: $M_{i,j} = \min(M_{i-1,j-1} + \lambda_s, M_{i-1,j},$
8: $M_{i-1,j+1} + \lambda_s) + M_{i,j}$
9: **end for**
10: **end for**
11: // Minimum energy path traceback
12: $d_L = \text{index}(\min(M_{L,1}, M_{L,2}, ..., M_{L,D}))$
13: $p_L' = p_L - d_L$
14: **for** $i = L - 1$ to 1 **do**
15: $d_i = \text{index}(\min(M_{i,d_{i+1}-1}, M_{i,d_{i+1}}, M_{i,d_{i+1}+1}))$
16: $p_i' = p_i - d_i$
17: **end for**

Results

Results

Estimated Right Stereo Contour with $\tau_d = 1$, $\lambda_o = 0.6$, $\lambda_s = 30$,d = 10:70

Results-2

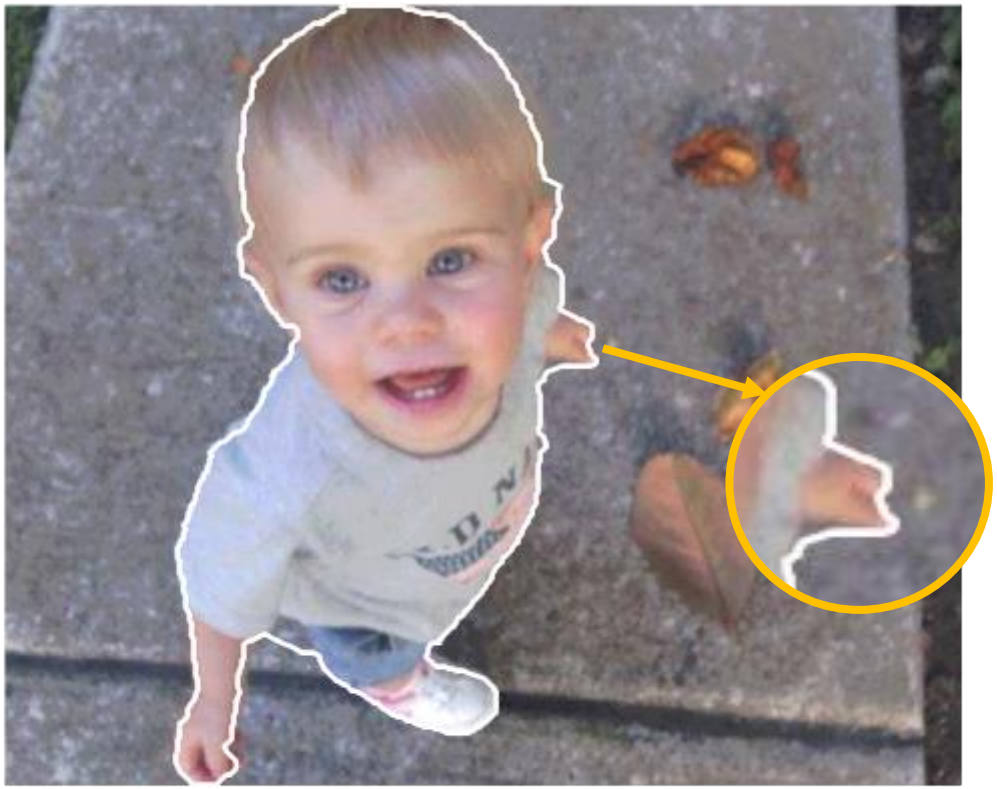
Results-2


Estimated Right Stereo Contour with $\tau_d = 1, \lambda_o = 0.6, \lambda_s = 30, d = 10{:}70$

Results-3

Left Stereo Image of a child

Estimated Right Stereo Contour with $\tau_d = 2$, $\lambda_o = 1$, $\lambda_s = 30$, d = 10:70



Results-4

Left Stereo Image of a shelf

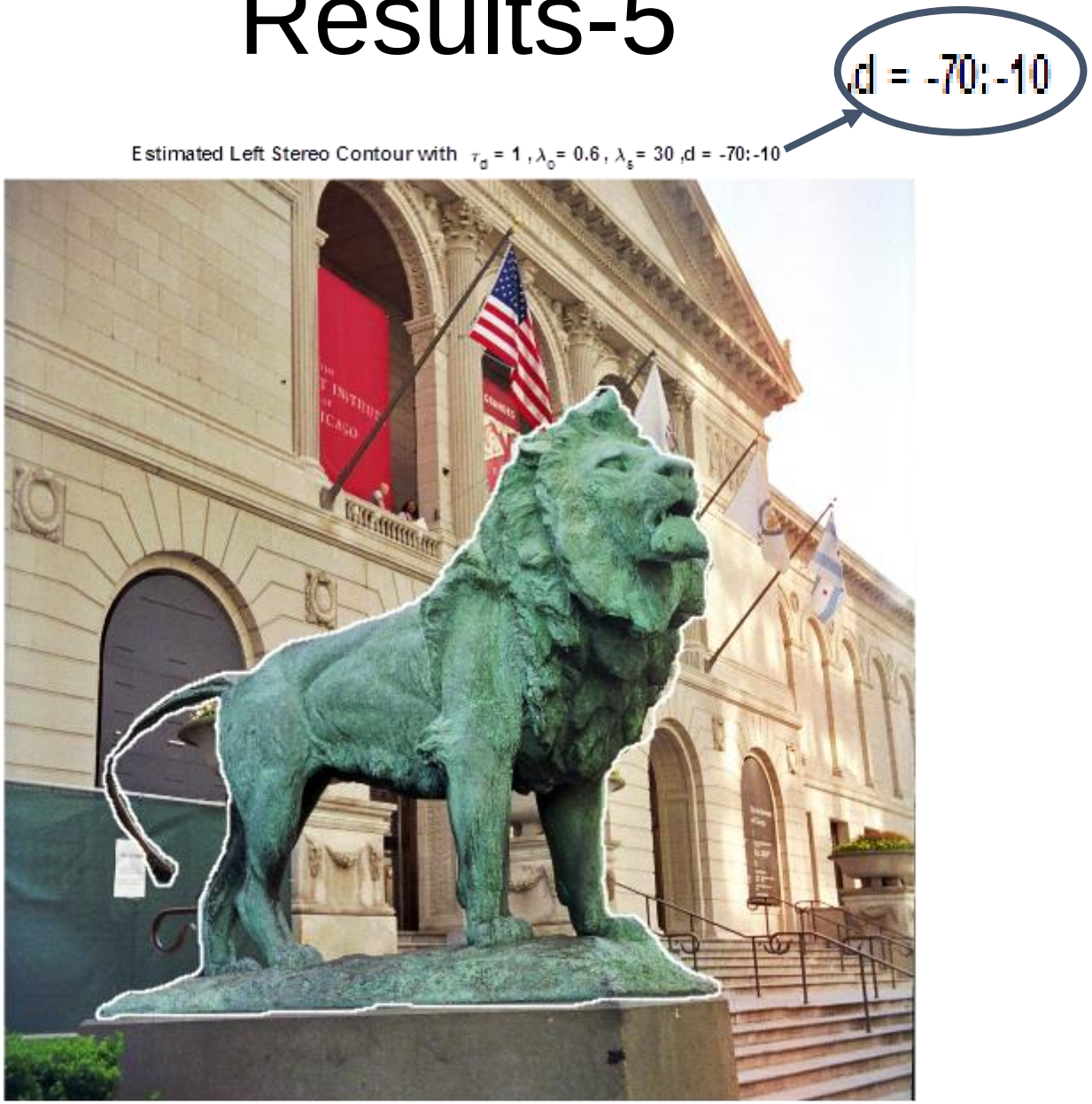
Results-4

Estimated Right Stereo Contour with $\tau_d = 1$, $\lambda_o = 0.6$, $\lambda_s = 30$,d = 150:200

Results-5

Right Stereo Image of a lionstatue

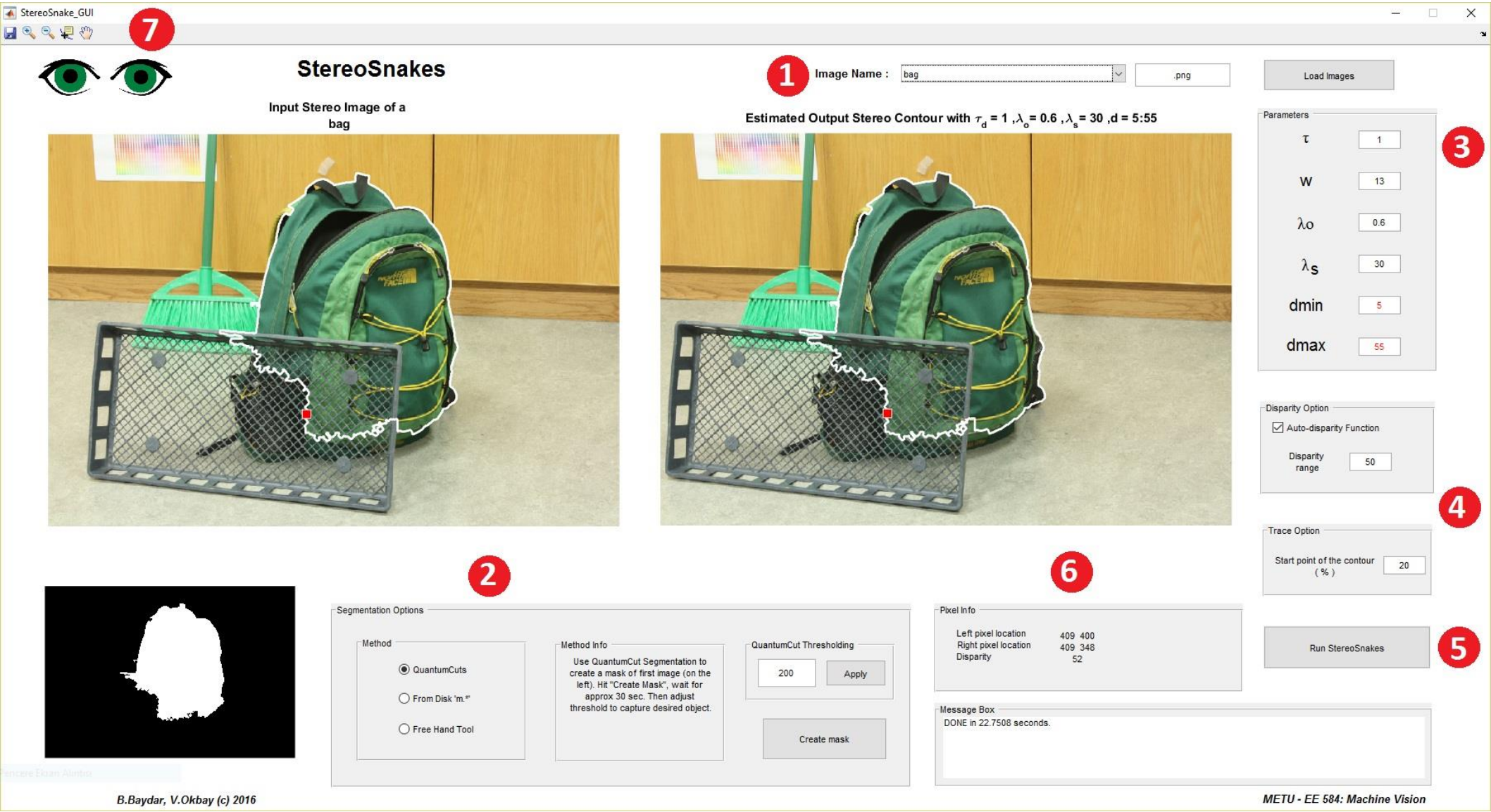
Results-5


,d = -70:-10
Estimated Left Stereo Contour with τ_d = 1 , λ_D = 0.6 , λ_s = 30 ,d = -70:-10

Future Work

- How choose first point of the contour ?
- How to estimate dmin and dmax ?
- *Spatial dependent disparity range*: usually left half of the input object contour has more displacement (switching from left stereo to right stereo).

GUI


StereoSnake_GUI
7
StereoSnakes
Input Stereo Image of a bag
1
Image Name :
bag
.png
Load Images
Estimated Output Stereo Contour with τ_d = 1 ,λ_o = 0.6 ,λ_s = 30 ,d = 5:55
Parameters
τ 1
w 13
λo 0.6
λs 30
dmin 5
dmax 55
3
Disparity Option
Auto-disparity Function
Disparity range 50
4
Trace Option
Start point of the contour (%) 20
2
6
Segmentation Options
Method
QuantumCuts
From Disk 'm.*'
Free Hand Tool
Method Info
Use QuantumCut Segmentation to create a mask of first image (on the left). Hit "Create Mask", wait for approx 30 sec. Then adjust threshold to capture desired object.
QuantumCut Thresholding
200
Apply
Create mask
Pixel Info
Left pixel location 409 400
Right pixel location 409 348
Disparity 52
Run StereoSnakes
5
Message Box
DONE in 22.7508 seconds.
B.Baydar, V.Okbay (c) 2016
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Thank you for your attention ...