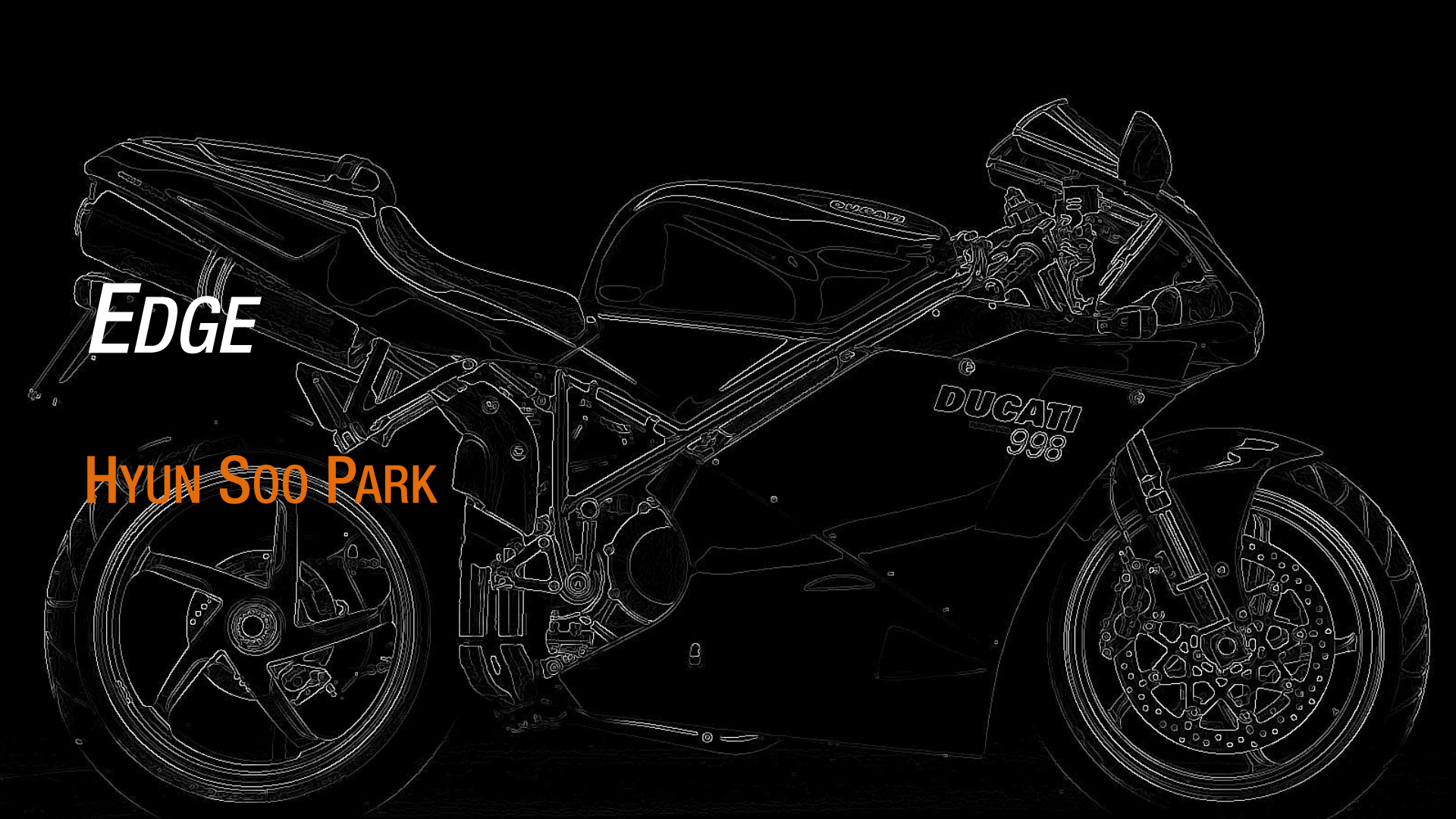
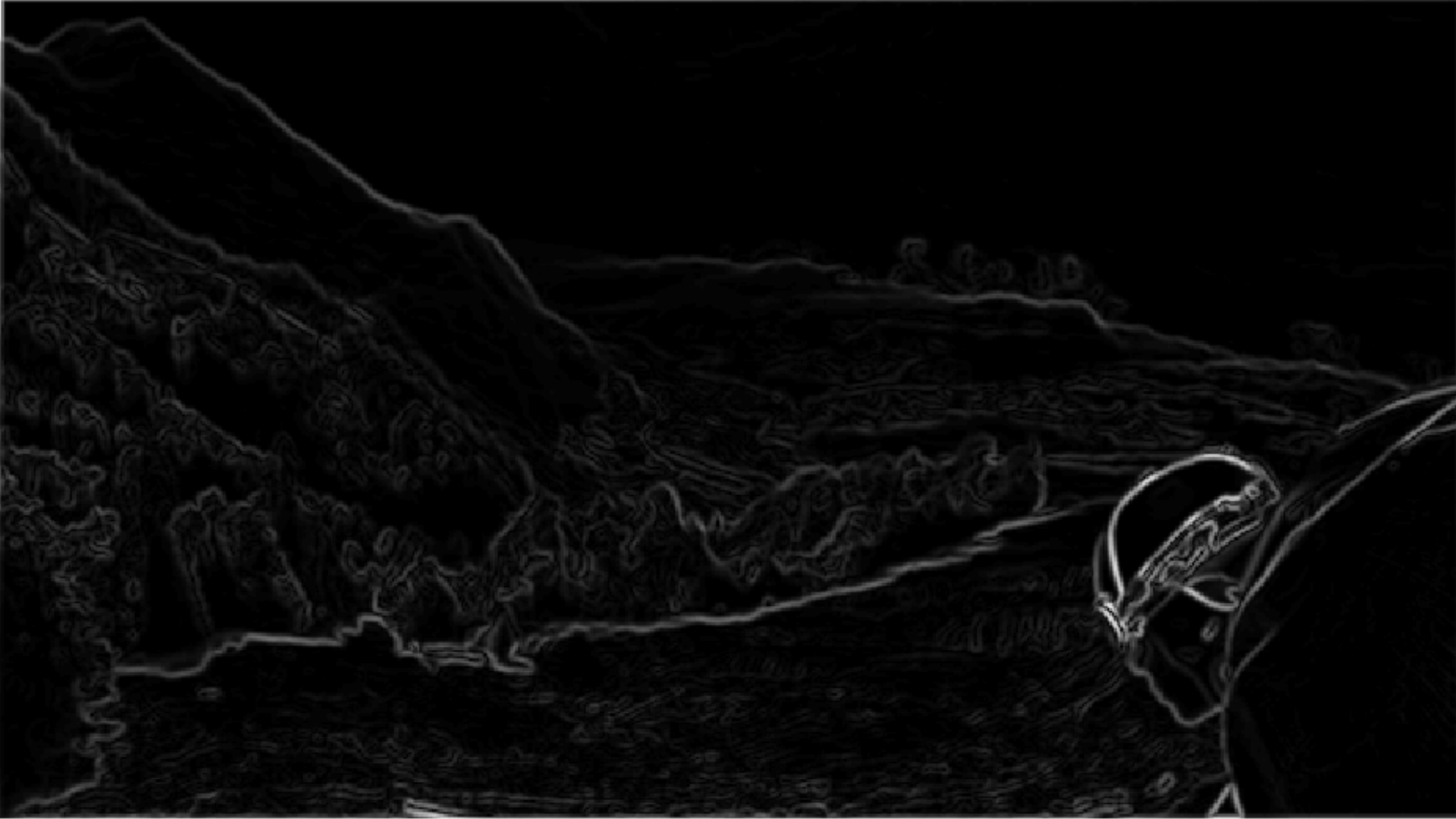




EDGE

HYUN SOO PARK

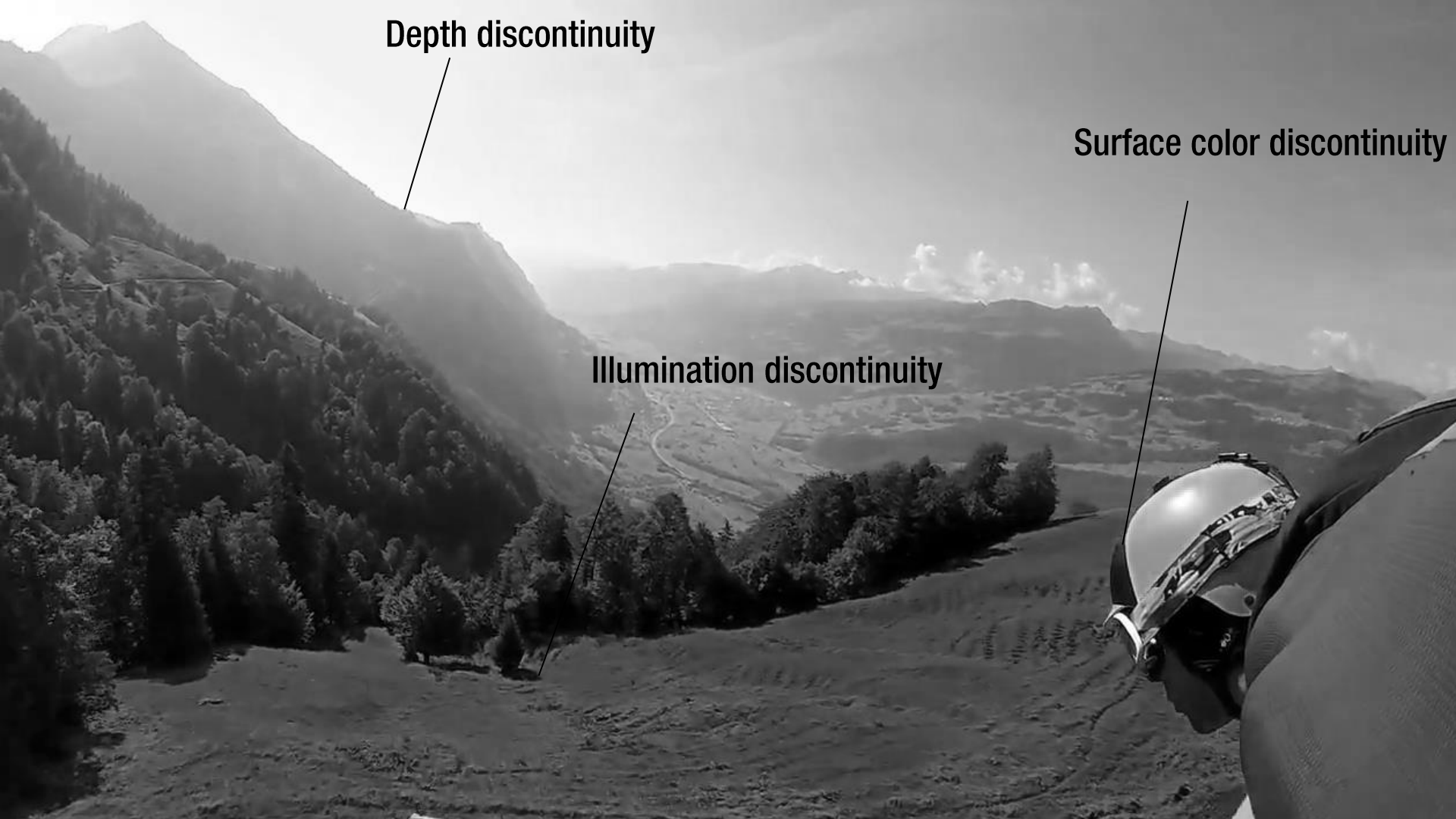




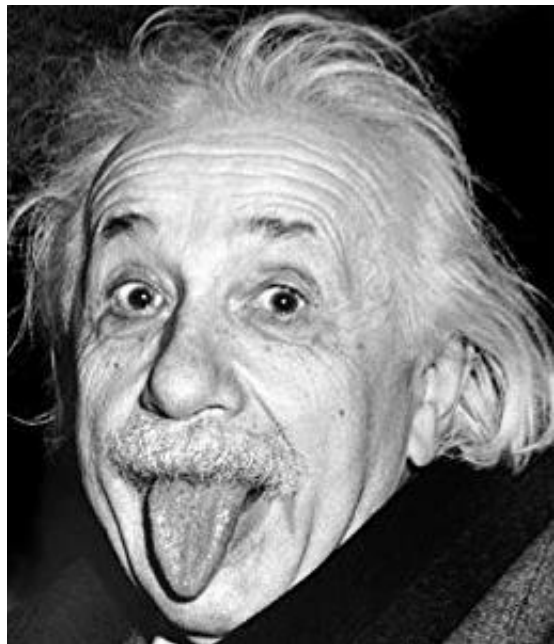
Depth discontinuity

Surface color discontinuity

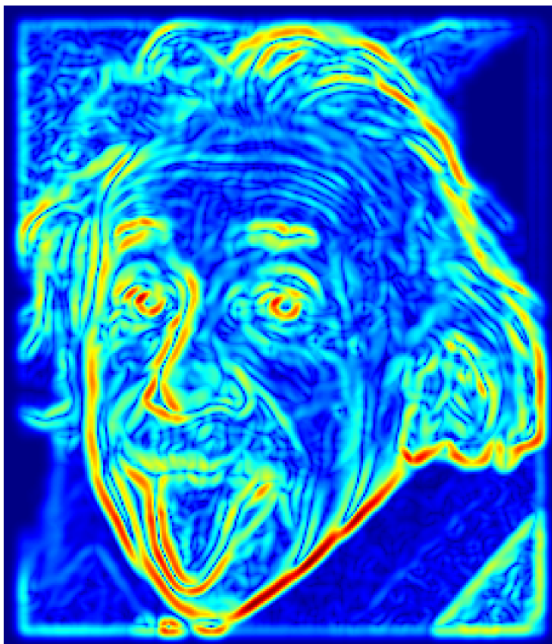
Illumination discontinuity



EDGE DETECTION: WOULD MAGNITUDE THRESHOLDING WORK?

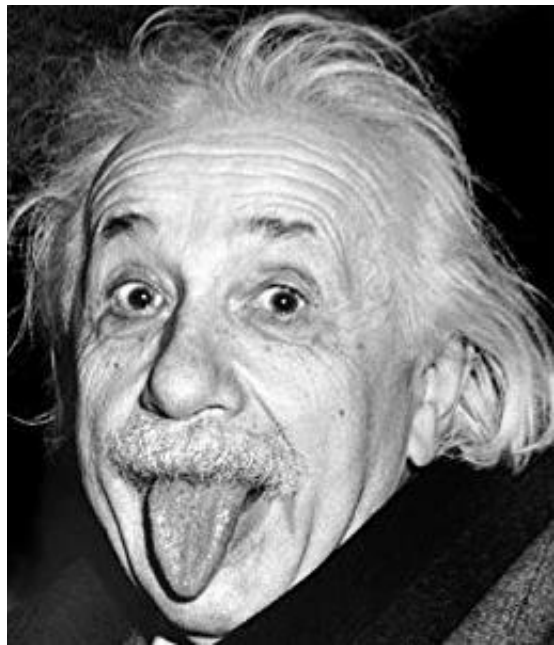


I



$$\|\nabla I\| > \varepsilon$$

EDGE DETECTION: WOULD MAGNITUDE THRESHOLDING WORK?

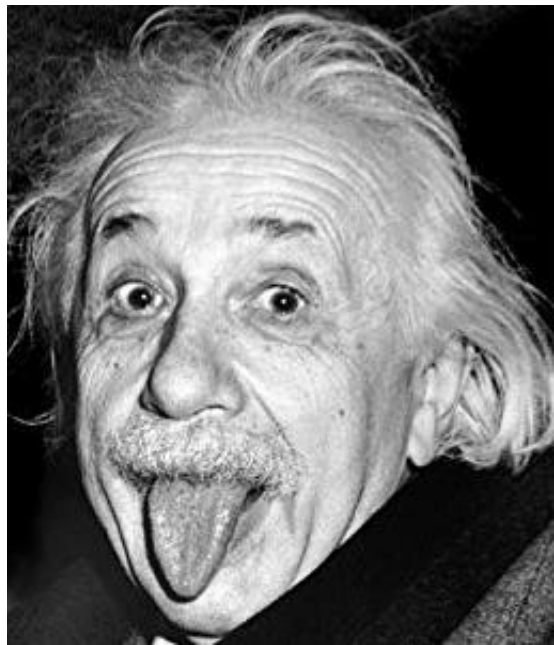


I

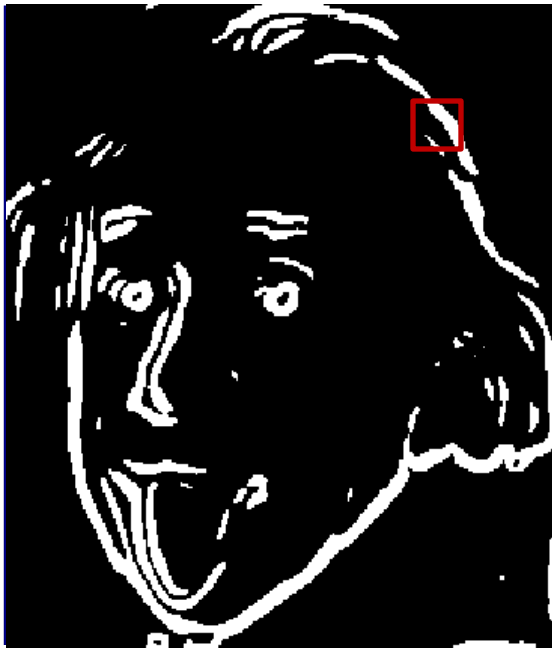


$$\|\nabla I\| > \varepsilon$$

EDGE DETECTION: WOULD MAGNITUDE THRESHOLDING WORK?

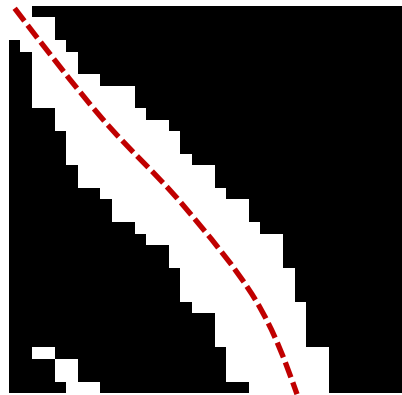


I

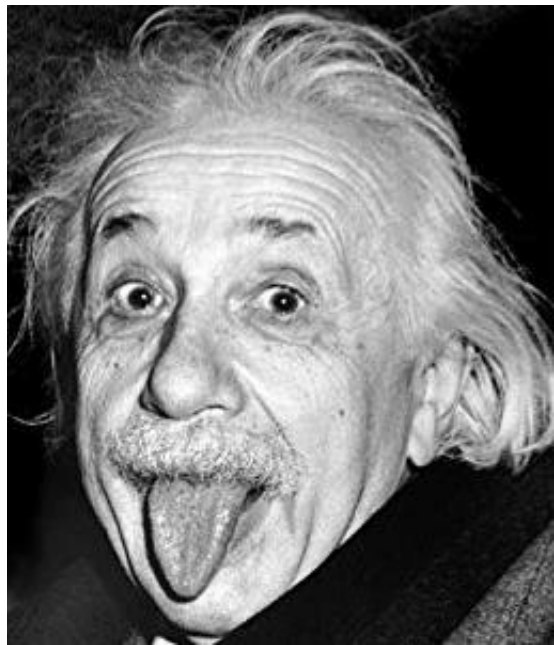


$\|\nabla I\| > \varepsilon$

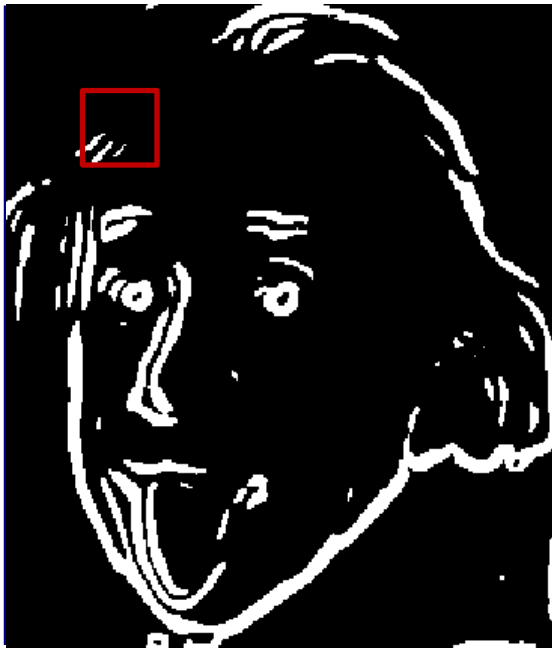
Non-locality



EDGE DETECTION: WOULD MAGNITUDE THRESHOLDING WORK?



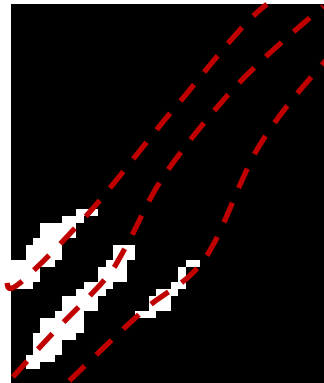
I



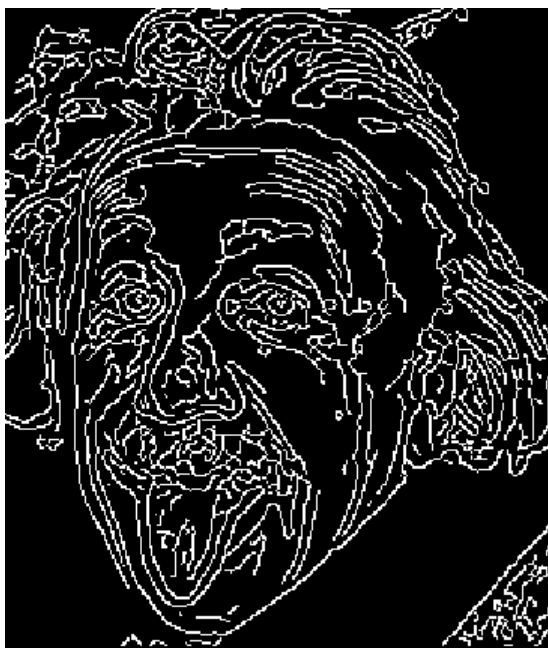
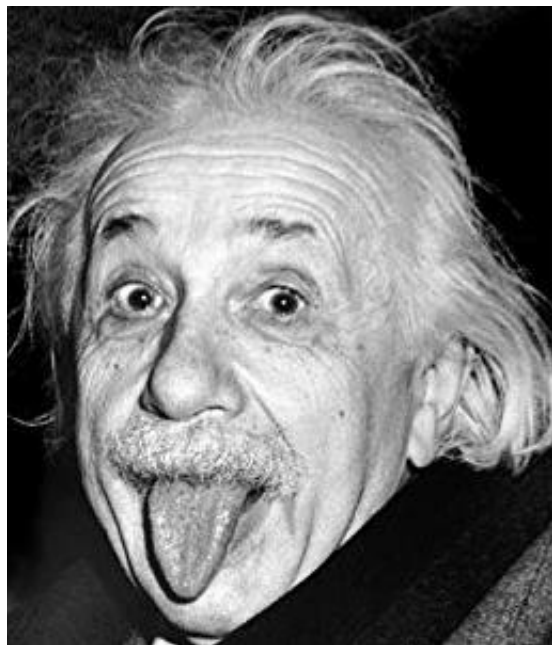
$$\|\nabla I\| > \varepsilon$$

Non-locality

Discontinuity



CANNY EDGE DETECTOR

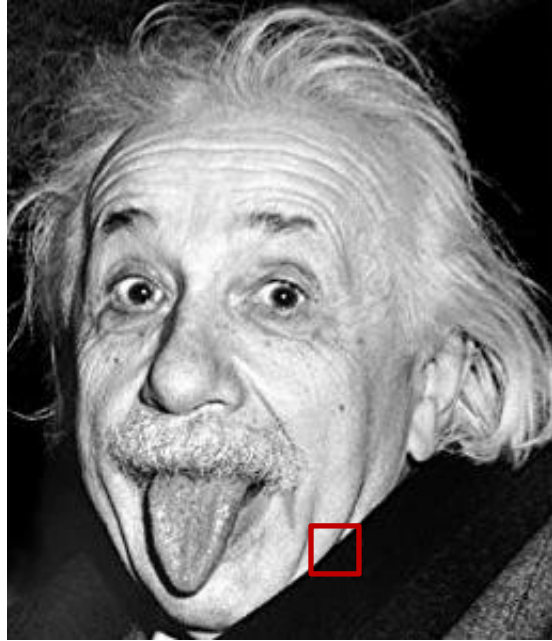


John F. Canny, UC Berkely

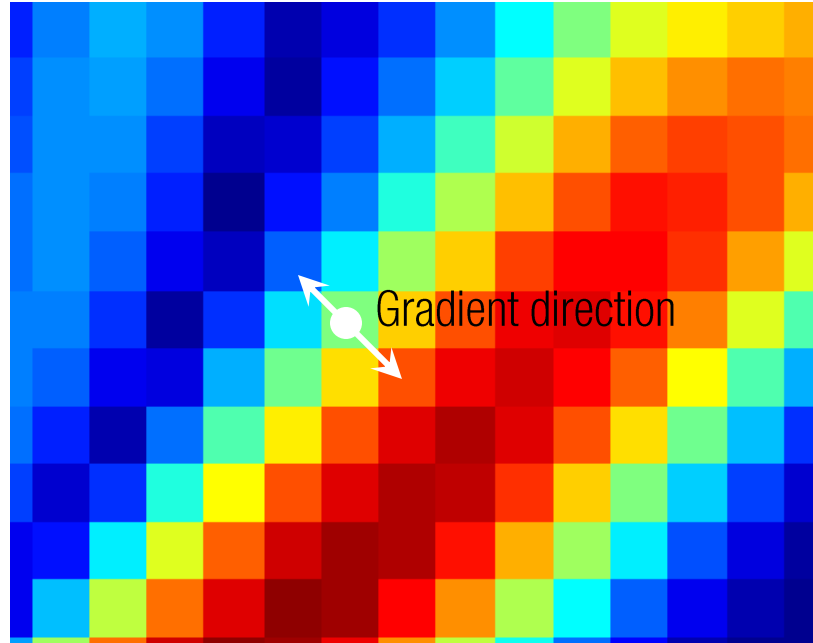
I

Canny, A Computational Approach to Edge Detection, TPAMI (1986)

EDGE LOCALIZATION: NON-MAXIMUM SUPPRESSION



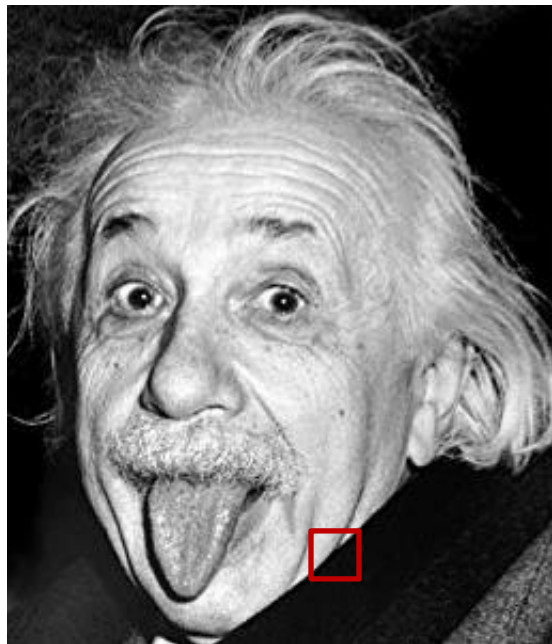
I



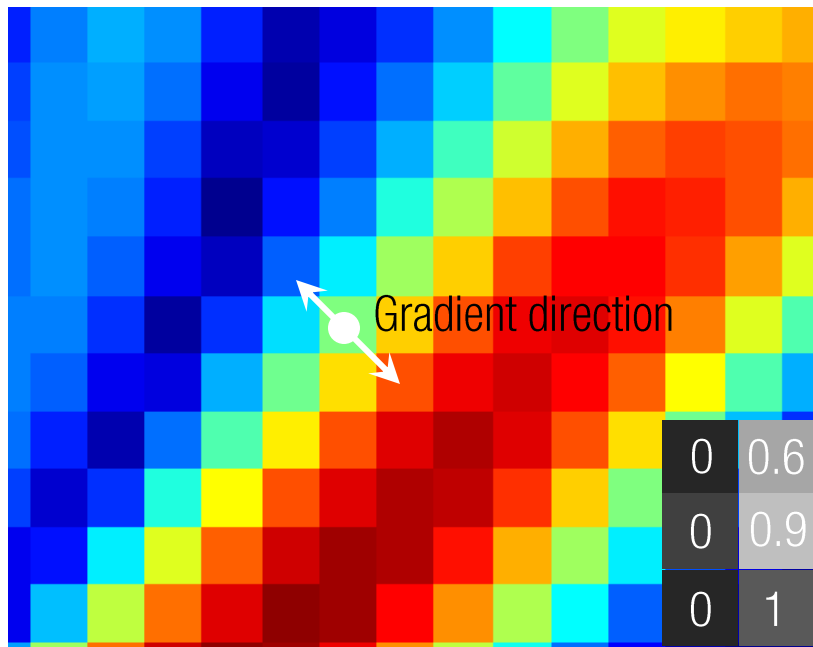
Edge response

Check if the pixel is
local maximum along
the gradient direction

EDGE LOCALIZATION: NON-MAXIMUM SUPPRESSION

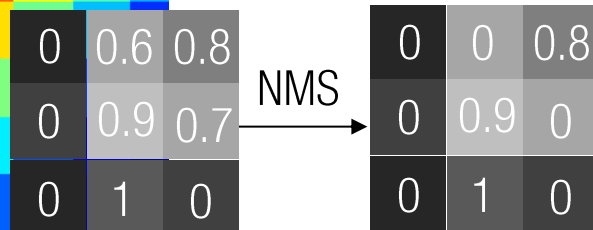


I

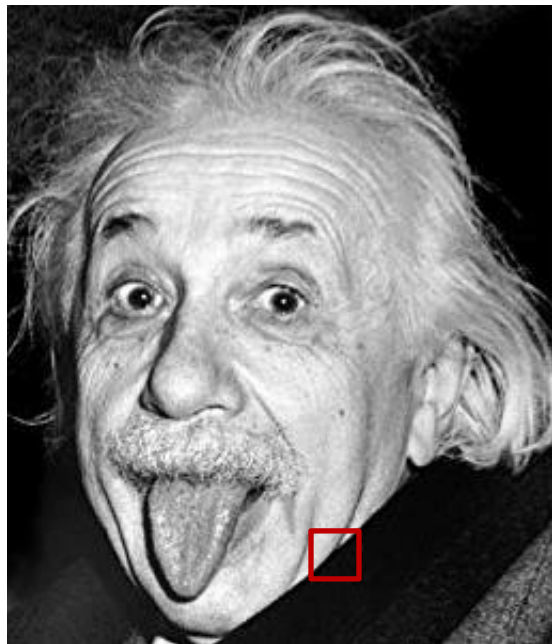


Edge response

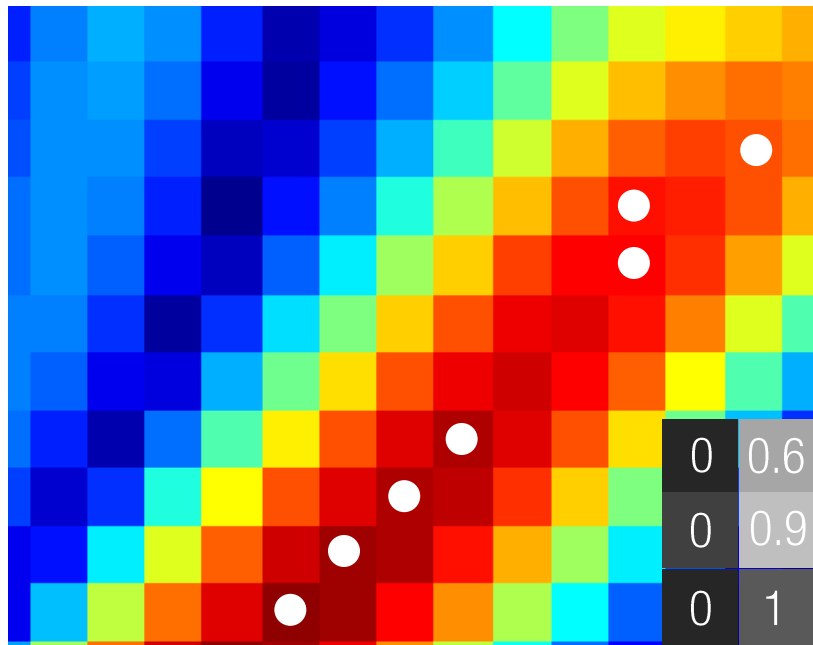
Check if the pixel is local maximum along the gradient direction



EDGE LOCALIZATION: NON-MAXIMUM SUPPRESSION

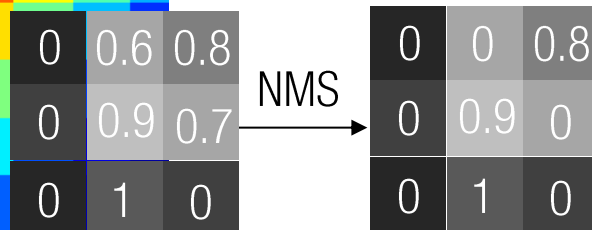


I



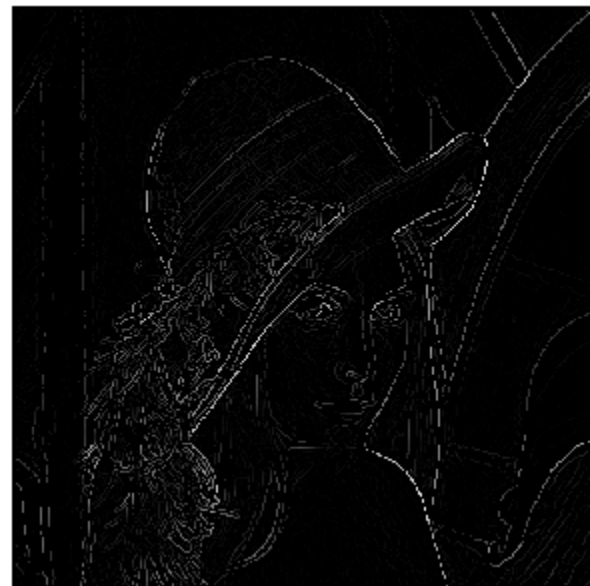
Edge response

Check if the pixel is local maximum along the gradient direction



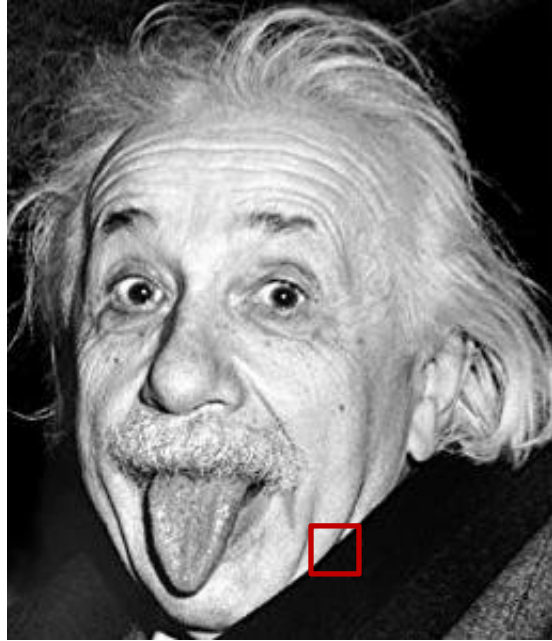


Thresholding

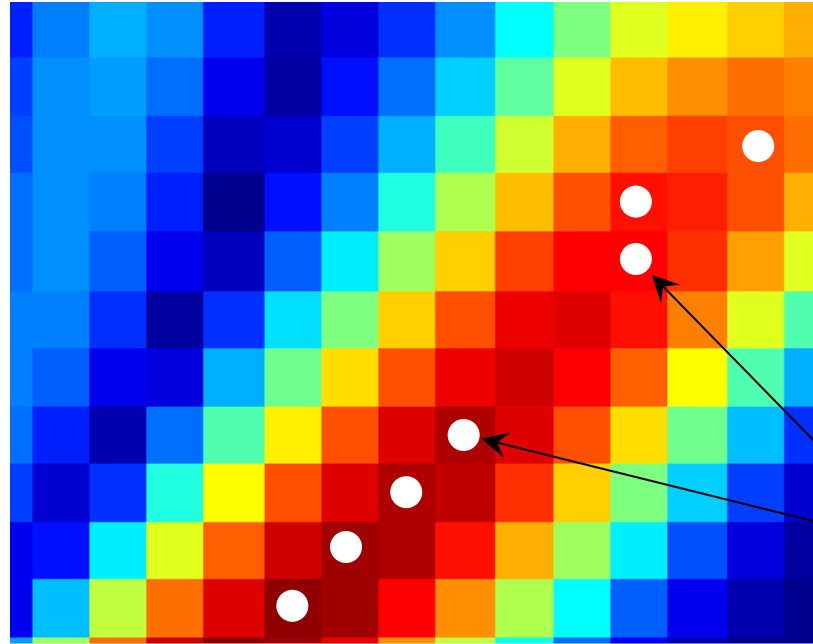


Localized edge

EDGE LINKING



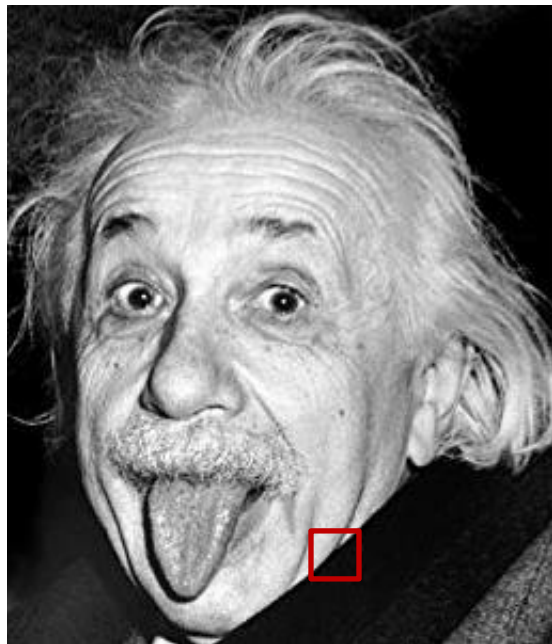
I



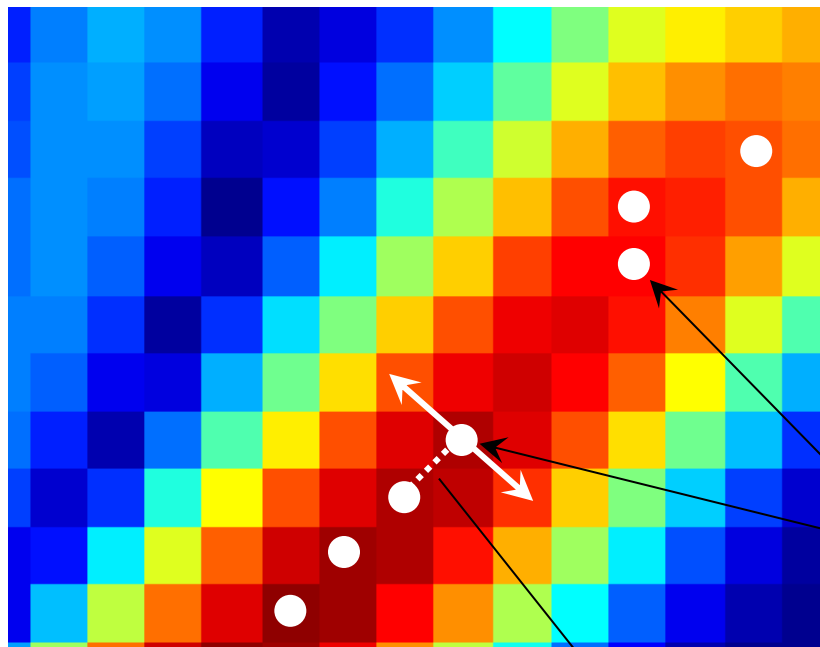
Edge response

Edge discontinuity

EDGE LINKING



I

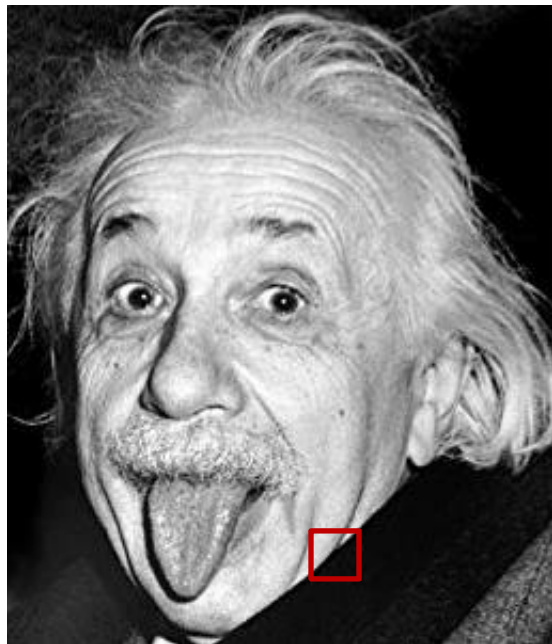


Edge response

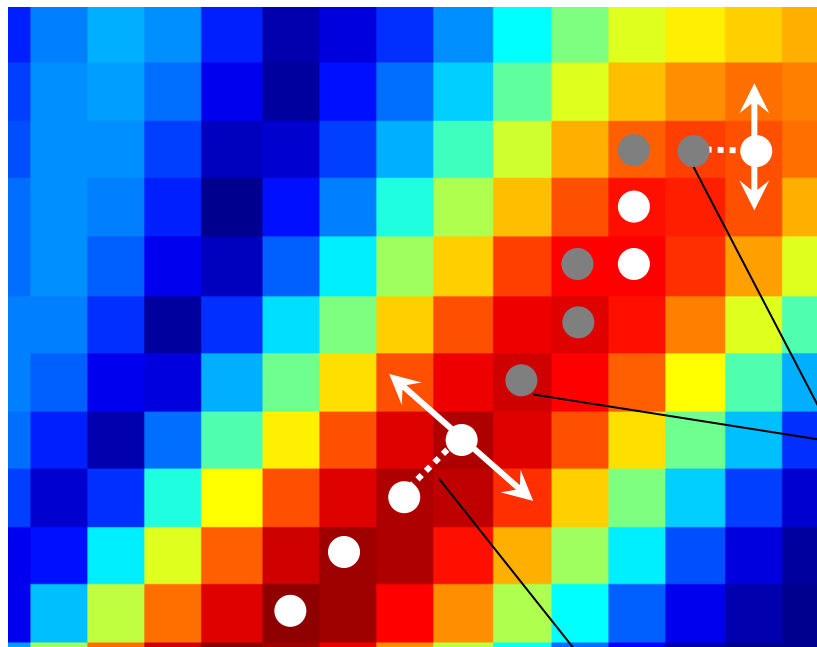
Edge linking

Edge discontinuity

EDGE PREDICTION



I

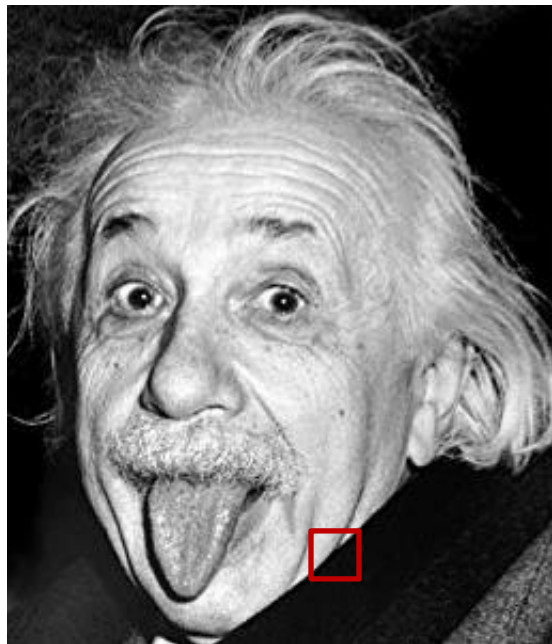


Edge response

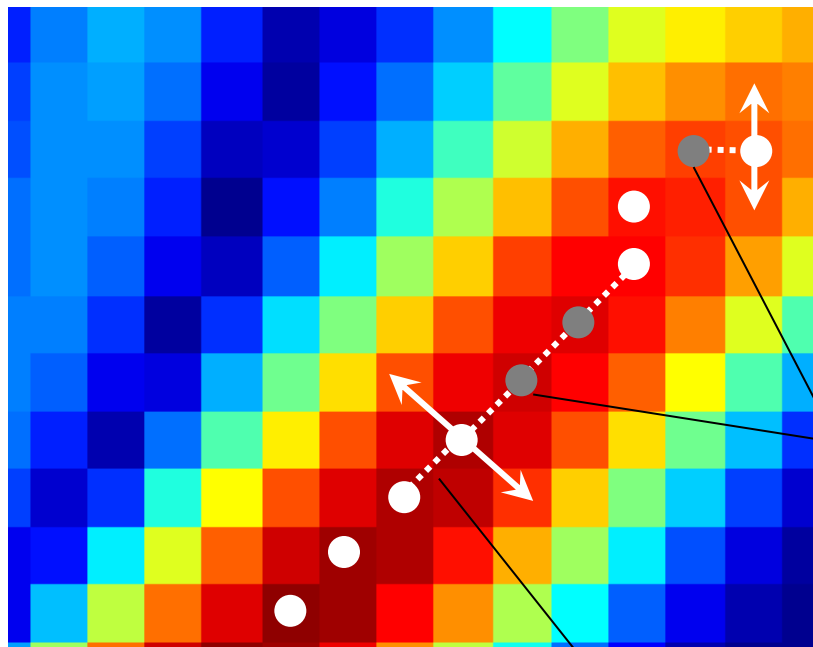
Edge linking

Next edge pixel prediction
→ Tangent to the edge

EDGE PREDICTION: HYSTERESIS



I

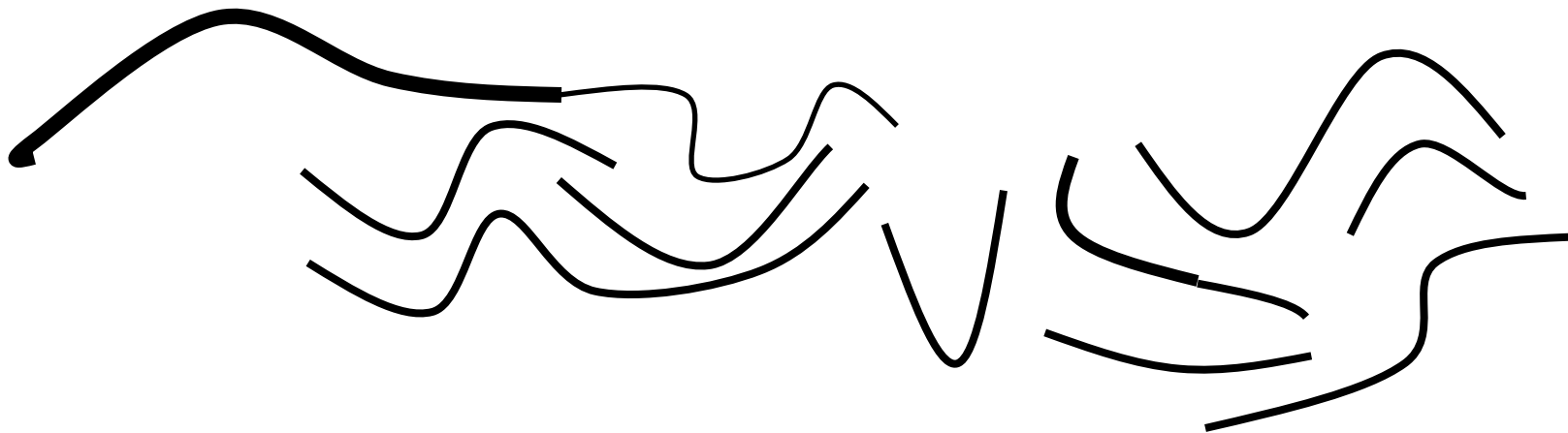


Edge response

Edge linking

Next edge pixel prediction
→ Tangent to the edge
Check if edge response
is sufficiently large

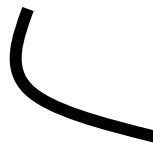
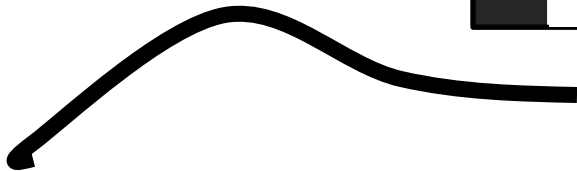
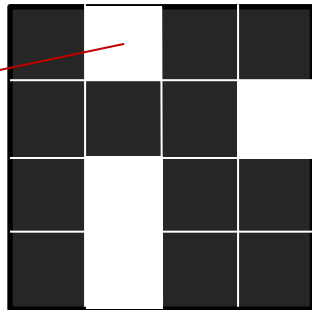
EDGE LINKING: HYSTERESIS



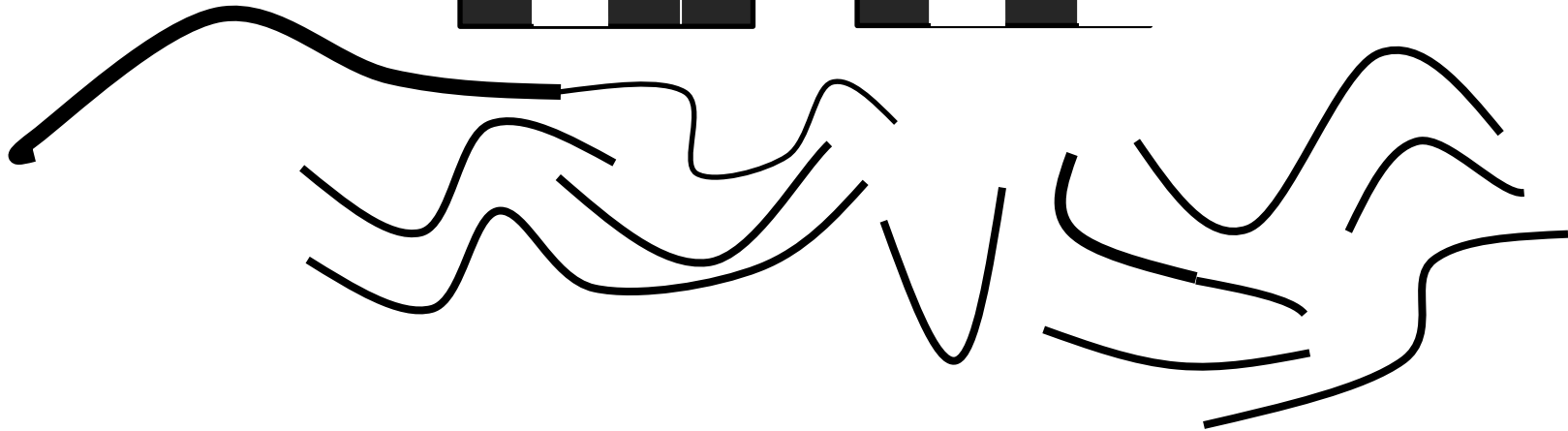
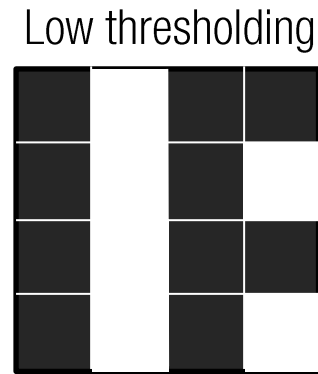
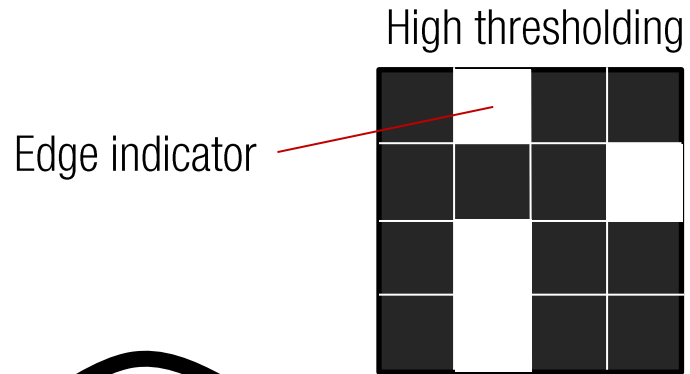
EDGE LINKING: HYSTERESIS

High thresholding

Edge indicator

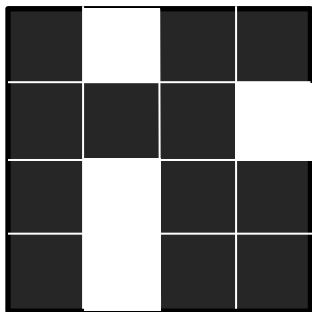


EDGE LINKING: HYSTERESIS

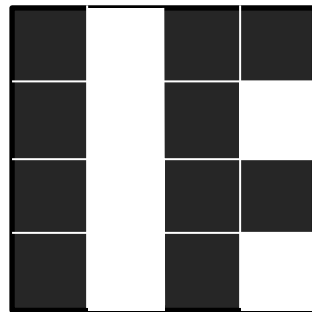


EDGE LINKING: HYSTERESIS

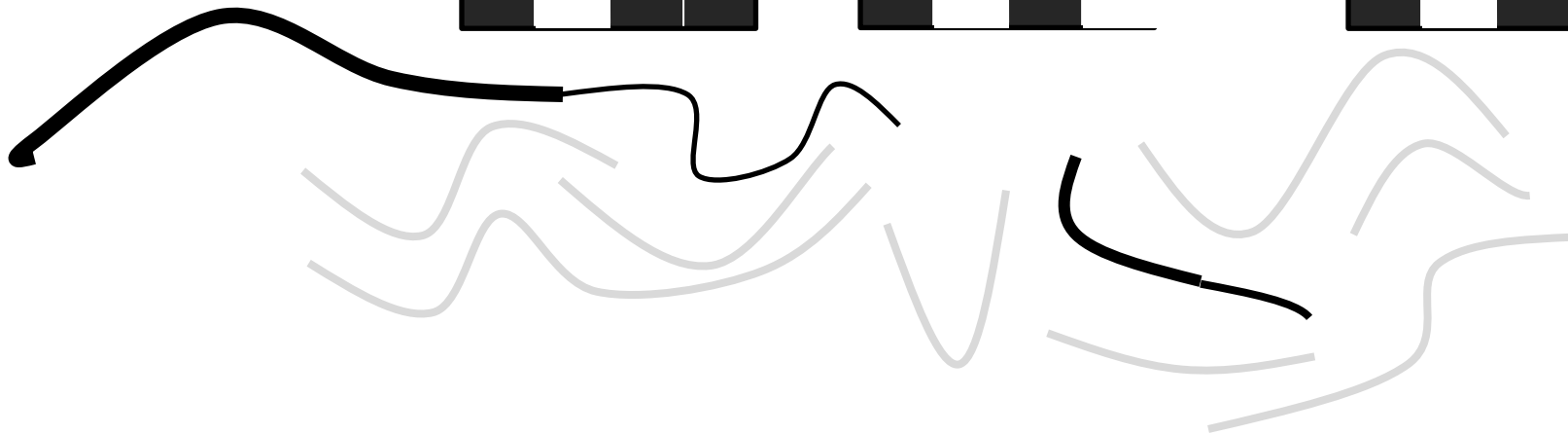
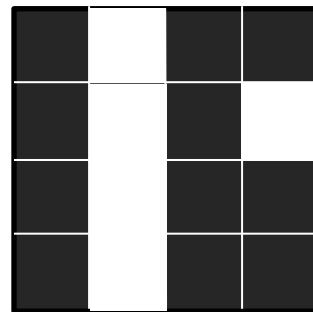
High thresholding



Low thresholding



Hysteresis



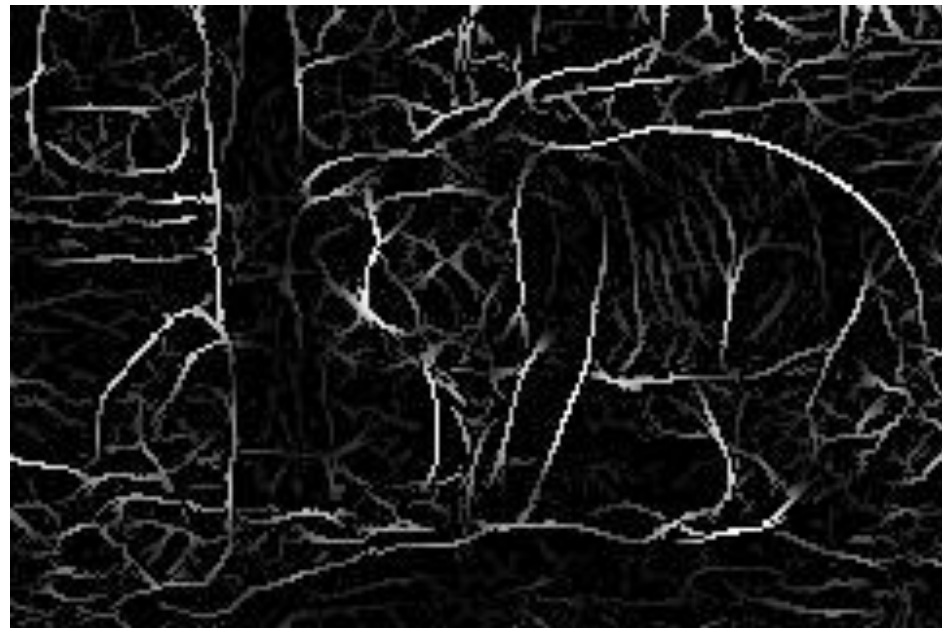


Localized edge



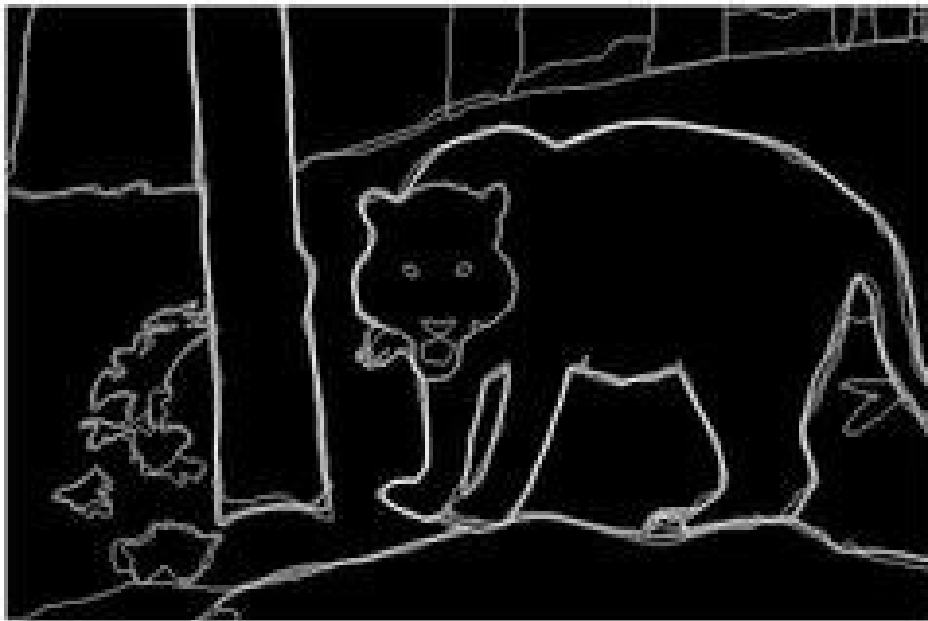
Edge linking

Is EDGE DETECTOR SOLVED?



Canny edges

Is EDGE DETECTOR SOLVED?

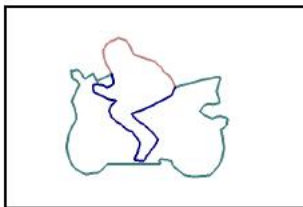


Human perceived edges

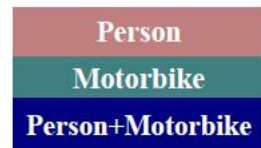
SEMANTIC EDGES



(a) original image



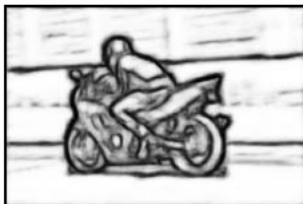
(b) ground truth



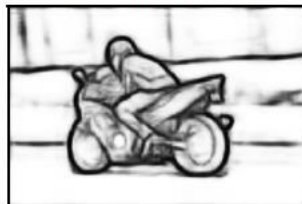
(c) color codes



(d) Side-1



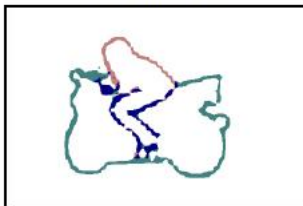
(e) Side-2



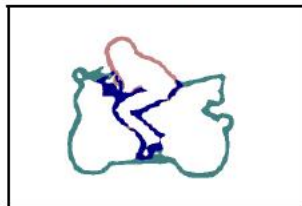
(f) Side-3



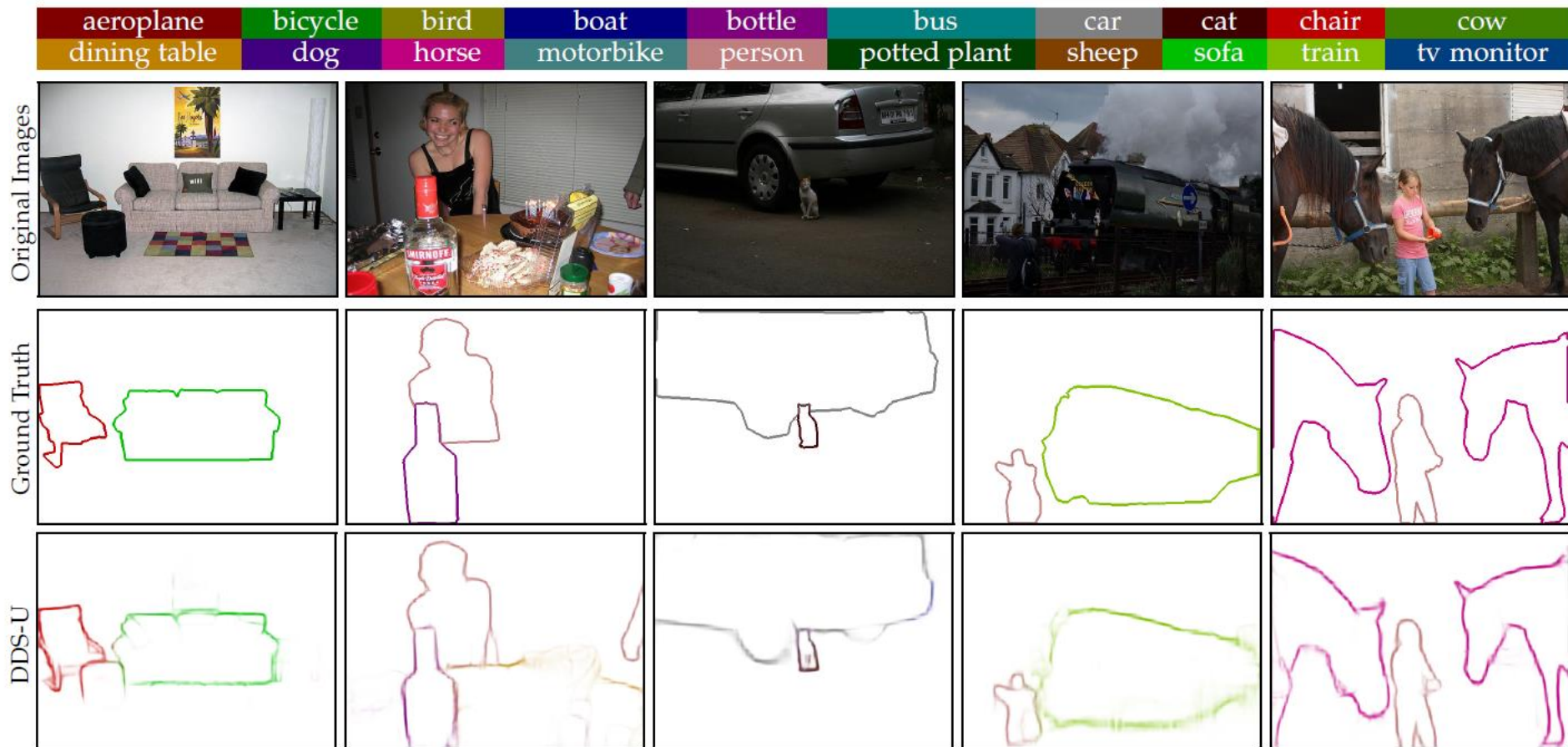
(g) Side-4



(h) Side-5



(i) DDS



Liu et al., “Semantic Edge Detection with Diverse Deep Supervision”, TPAMI (2018)



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ShadowDraw

Real-Time User Guidance for Freehand Drawing

Yong Jae Lee

U. Of Texas at Austin

C. Lawrence Zitnick

Microsoft Research

Michael F. Cohen

Microsoft Research

SIGGRAPH 2011

