EFFICIENT DETECTION OF FAINT CURVED EDGES IN NOISY IMAGES

Ofir N., Galun M., Nadler B., Basri R. - Weizmann Institute of Science
{yehonatan.ofir, meirav.galun, boaz.nadler, ronen.basri}@weizmann.ac.il

Goals

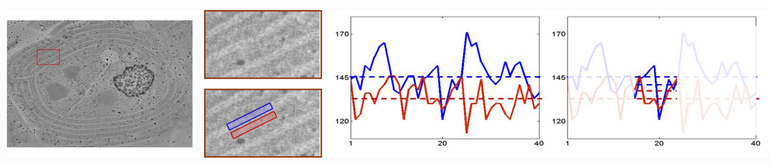
Answer the following fundamental questions:
- How faint an edge can be and still be detected?
- What is the computational complexity needed for detection of faint edges?

Abstract

We introduce an efficient method to detect faint curved edges in noisy images. The first question we address is how to efficiently detect curved edges. The second question we address is how to decide if a curve in the image indeed corresponds to a (possibly faint) edge. Our method takes advantage of statistical priors on edge contrast and shape. As our experiments demonstrate, compared to previous works our algorithm is more efficient and obtains higher quality of edge detection.

Matched Filter

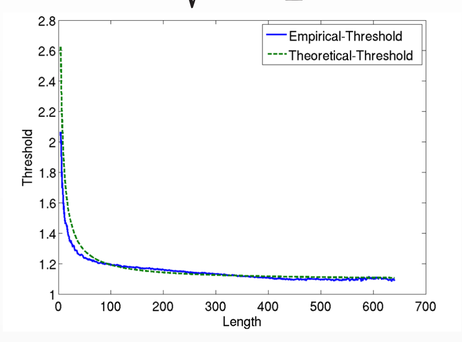
Faint edges can be detected using matched filters, at all lengths and orientations [1].



Detectable Contrast

Maximal contrast of a curve in a pure noise image:

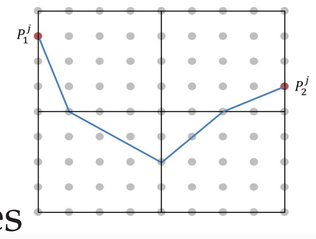
$$T(L) = \sqrt{\frac{2\log(6N)}{L}} + c$$



Efficient Detection

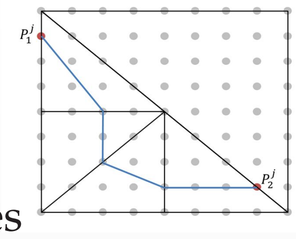
Quad Pyramid [2]

$\log_4(N)$ levels
$O(N^{2.5})$ operations
Quad tree of rectangles
Stitching of 4 sub-curves
$6N \cdot 2^{0.75L}$ curves of length L

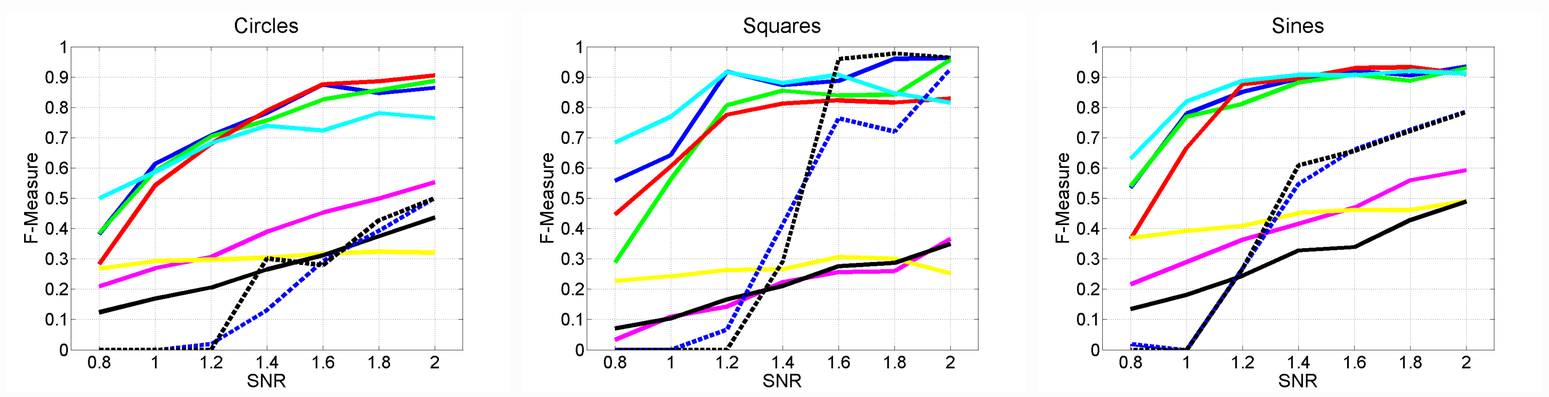


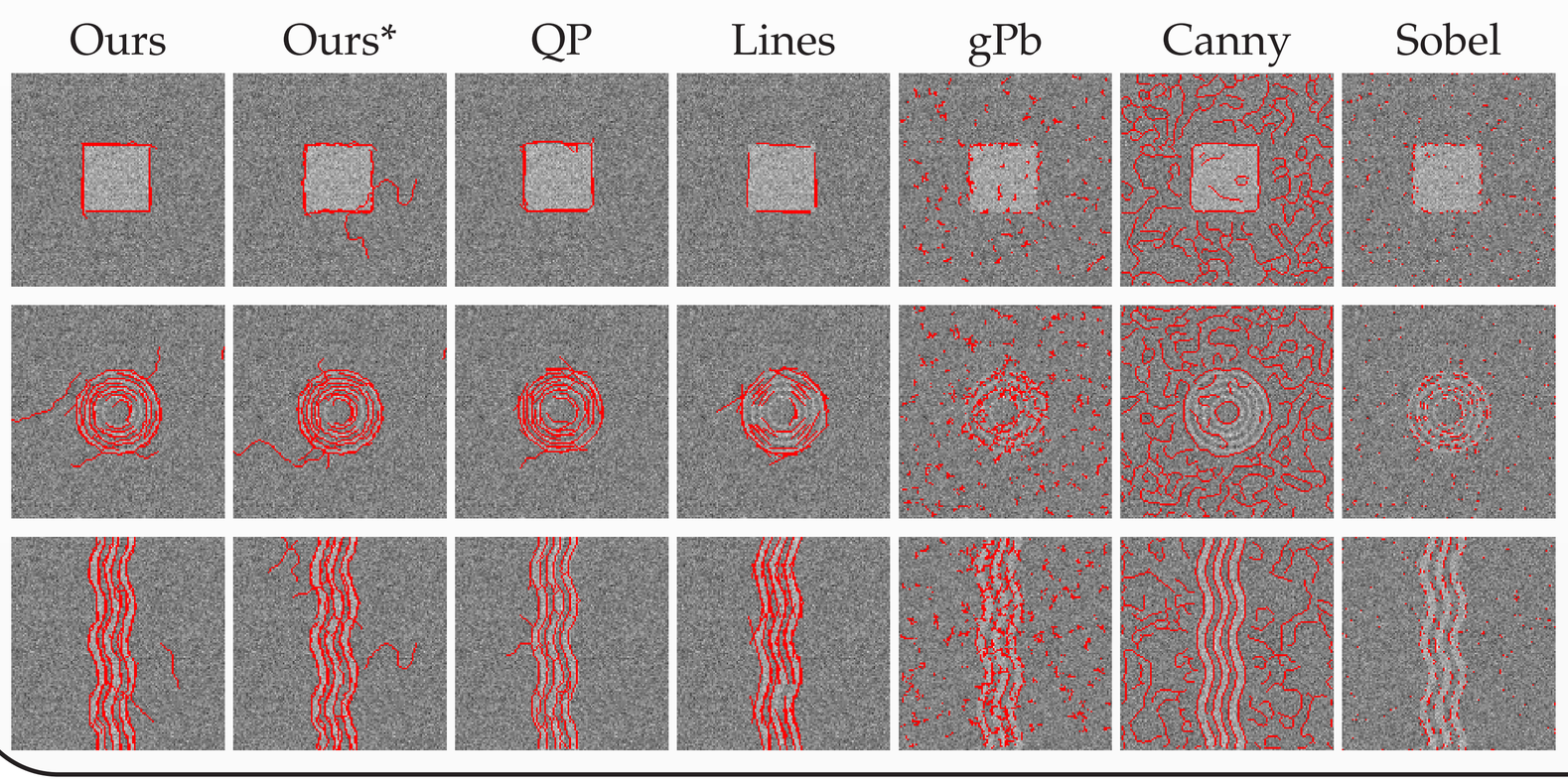
Triangle Partition Tree (Our Method)

$\log_2(N)$ levels
$O(N^{1.5})$ operations
Binary tree of triangles
Stitching of 2 sub-curves
$6N \cdot 2^{0.66L}$ curves of length L



Results





References

[1] Galun et al., Multiscale Edge Detection, in *ICCV*, 2007
[2] Alpert et al., Detecting Faint Curved Edges in Noisy Images, in *ECCV*, 2010