The effect of noise on computational T-Junction detection in images

Bachelor Thesis

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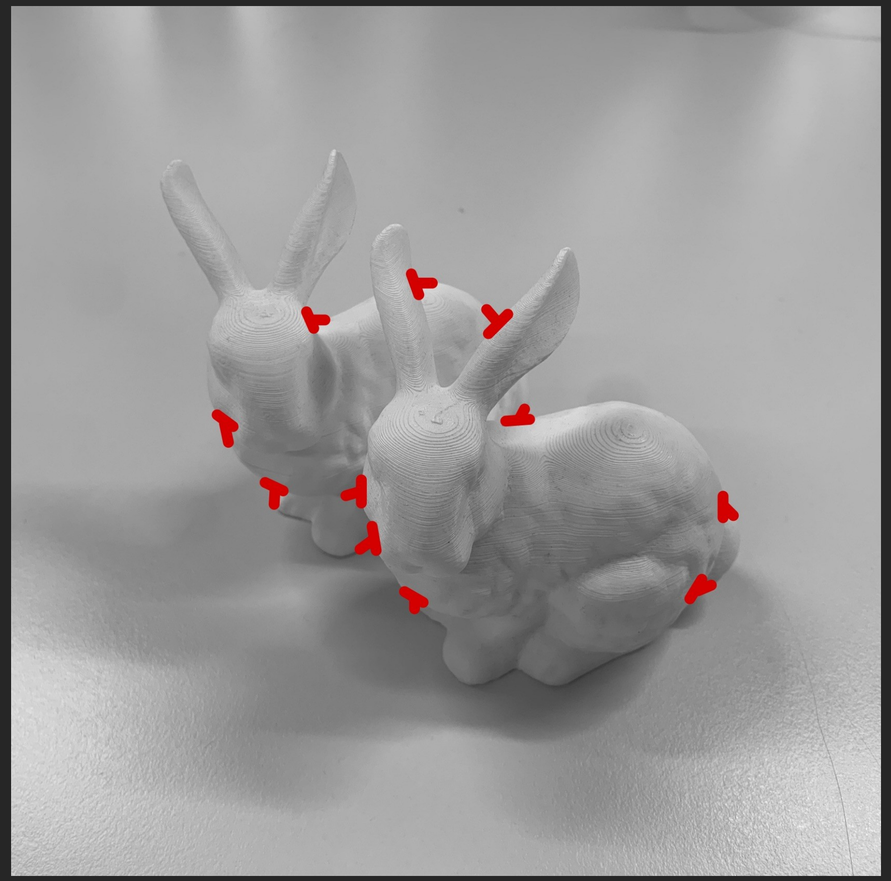
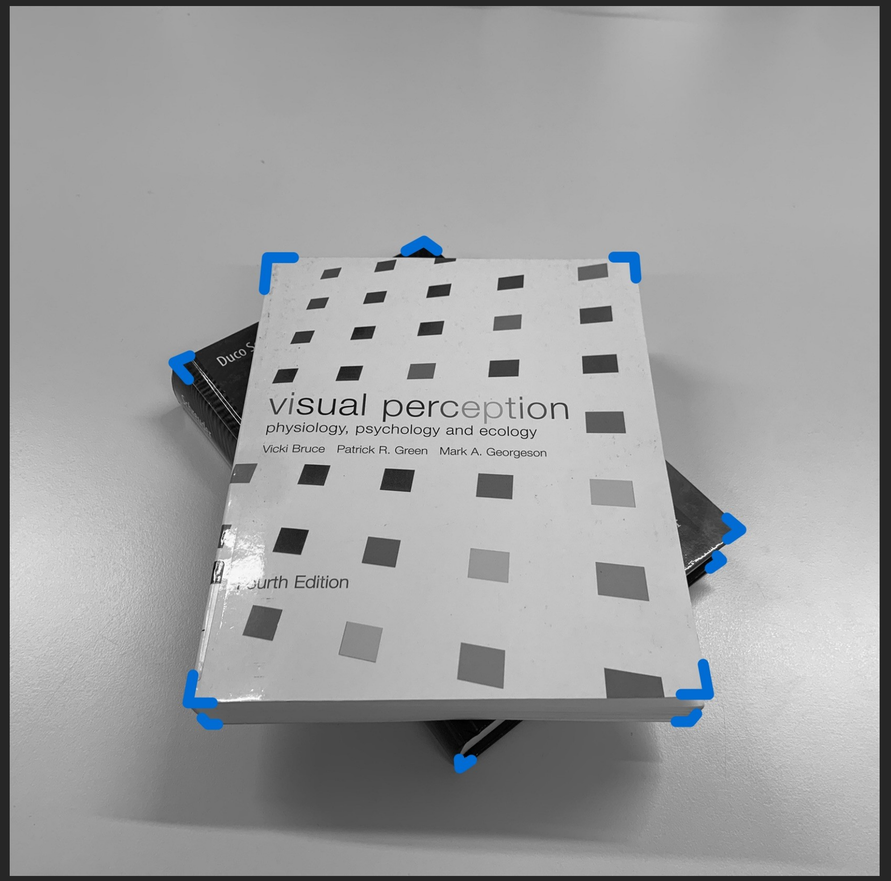
High-Curvature Points / Junctions

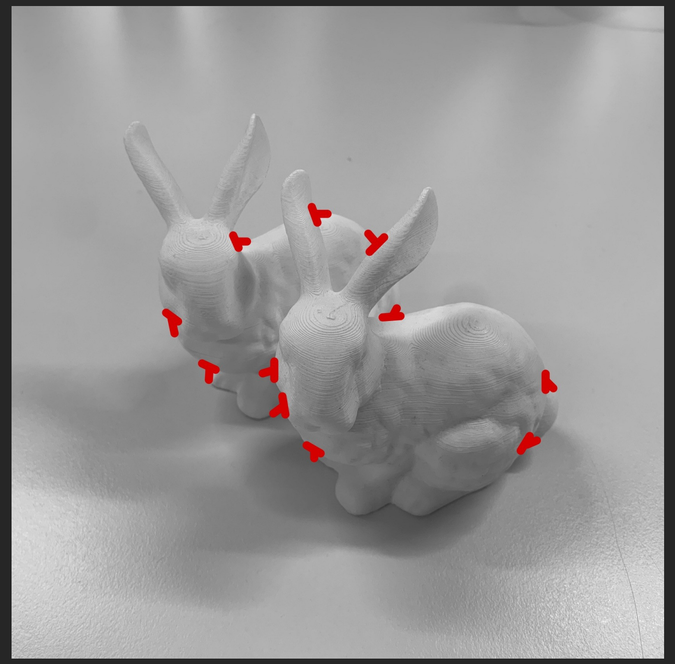
Basic Terminology & Motivation

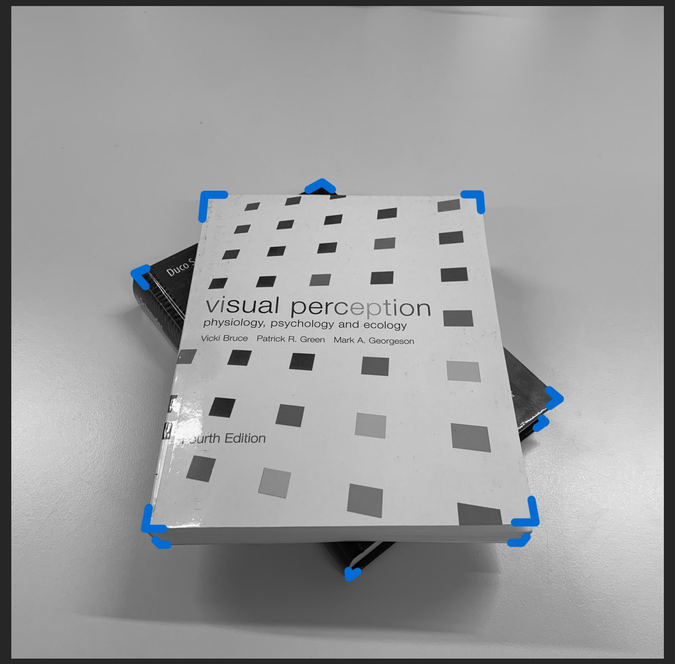




High-Curvature Points / Junctions

Basic Terminology & Motivation



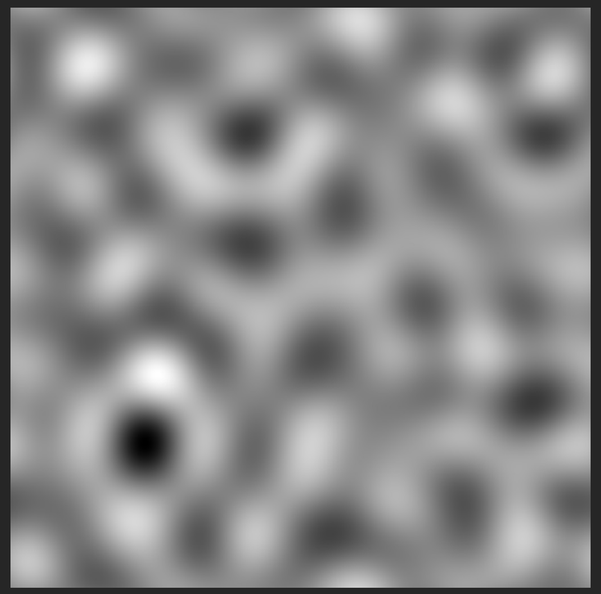


T → T-Junction

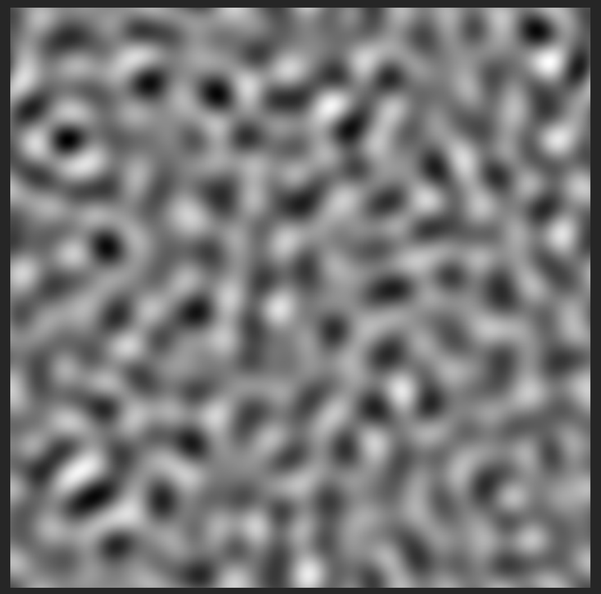
L → L-Junction

Noise

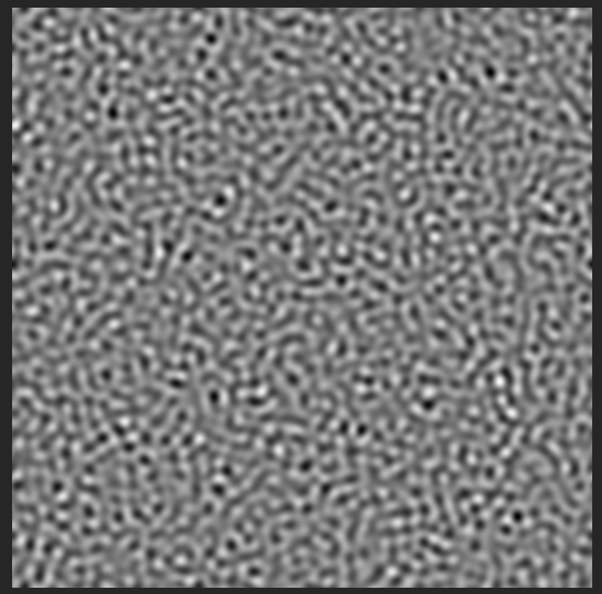
Basic Terminology & Motivation



Narrowband noise, cf=0.005cpd



Narrowband noise, cf=0.01cpd



Narrowband noise, cf=0.03cpd

Motivation

Basic Terminology & Motivation

- Since junctions can cause a layer scission, is there an algorithm that can detect junctions in images? → Yes
- How does its output change, if noise is added to the images?

Motivation

Basic Terminology & Motivation

The effect of noise on computational T-Junction detection in images

Noise at different center-frequencies

Number of detected T-Junctions

The algorithm

Basic Terminology & Motivation

- Proposed in the Paper “Contours, Corners and T-Junctions Detection Algorithm” by Antoni Buades, Rafael Grompone von Gioi and Julia Navarro
- The only paper (I could find) that provides the sourcecode

In- and Output

Basic Terminology & Motivation

Input

Greyscale Image

Colored Contours
and Junctions

Output

Grey Contours
and Junctions

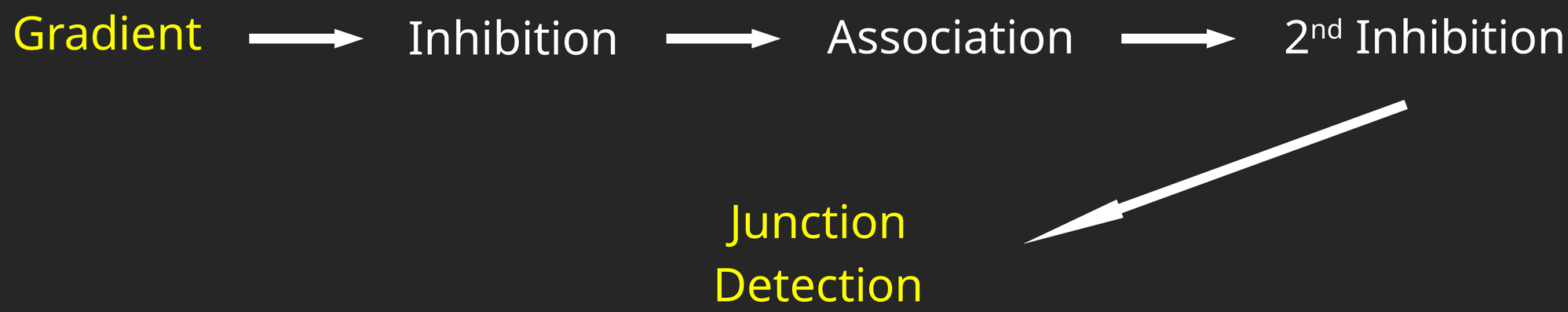
Contours.txt

Junctions.txt

Classification and
Coordinates

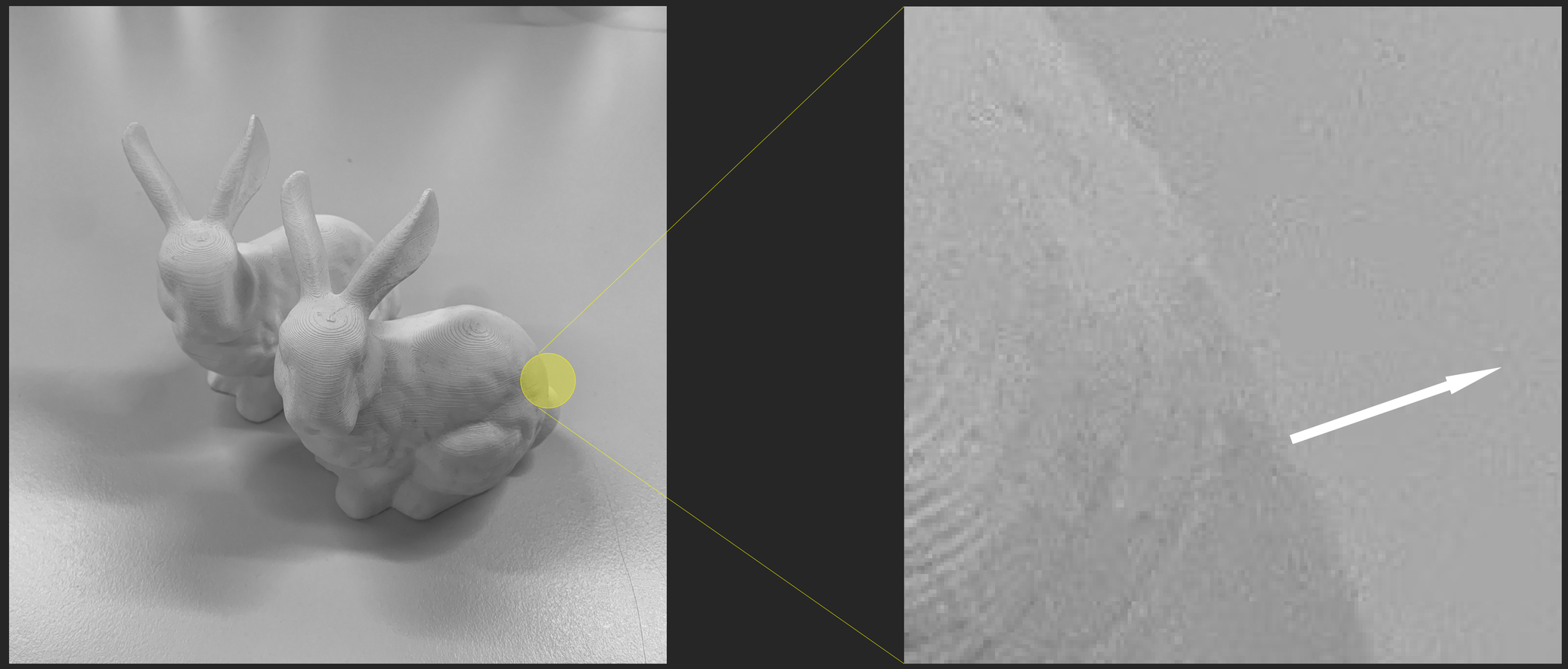
Procedure

Basic Terminology & Motivation



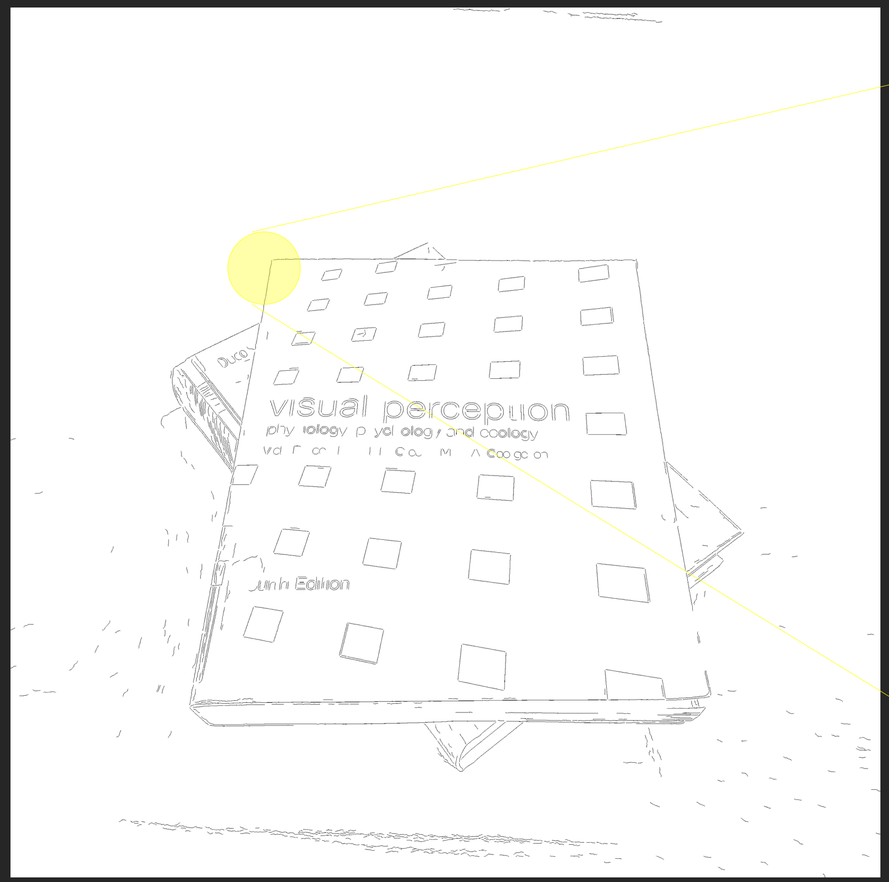
Gradient determination

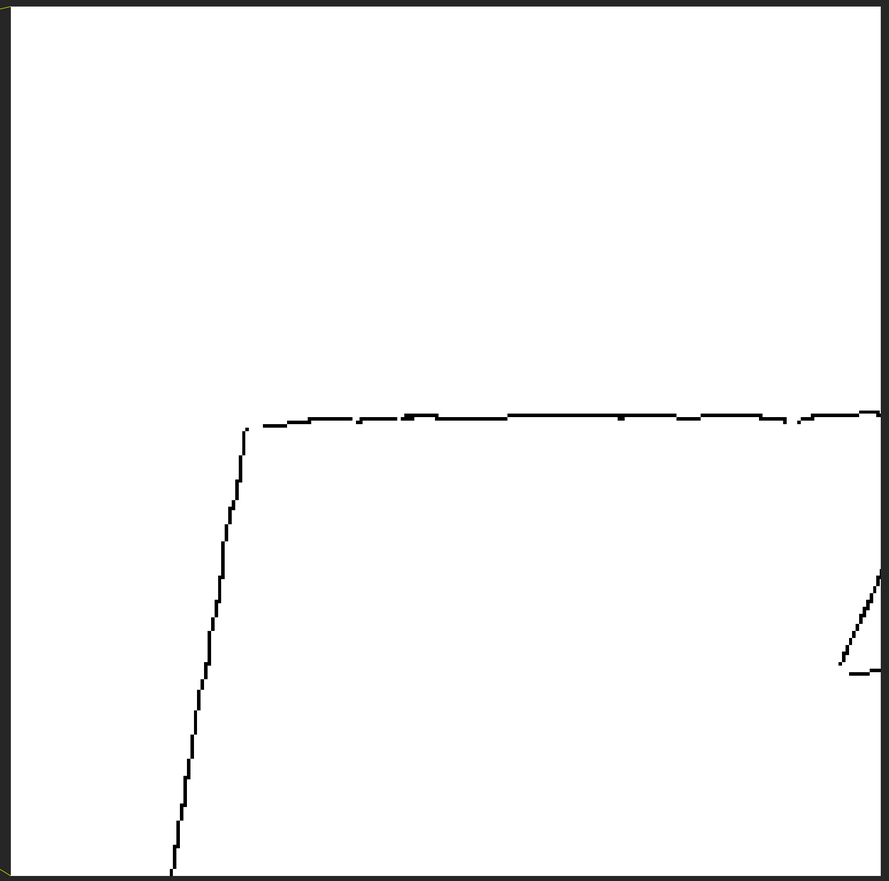
Basic Terminology & Motivation



Junction Detection

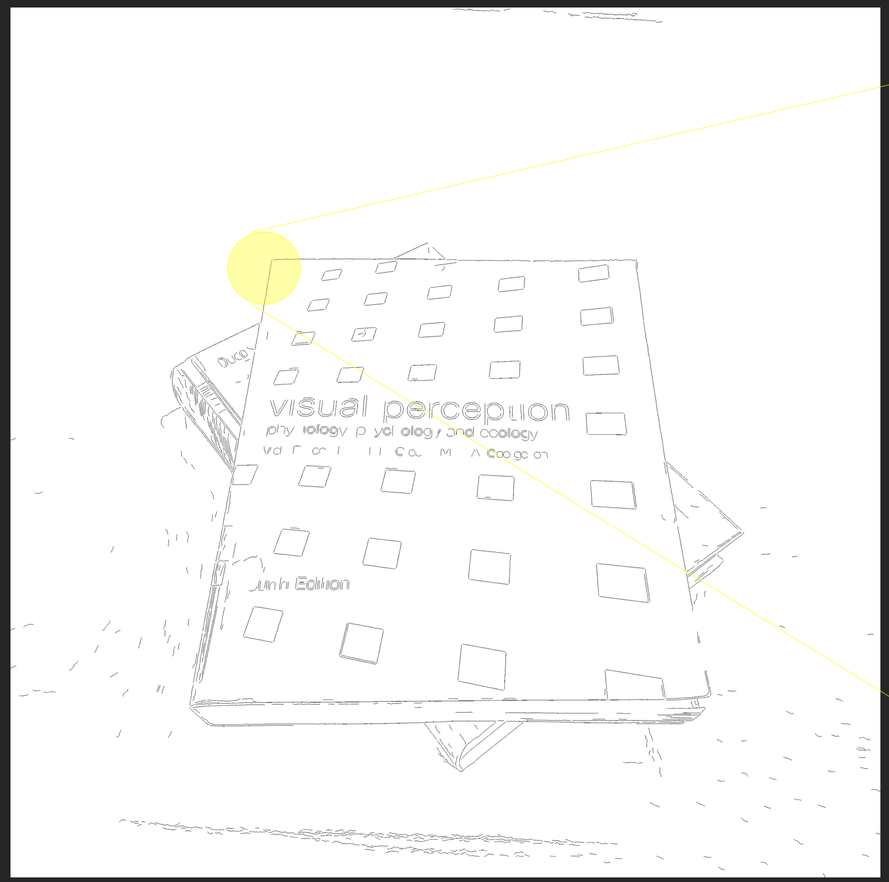
Basic Terminology & Motivation

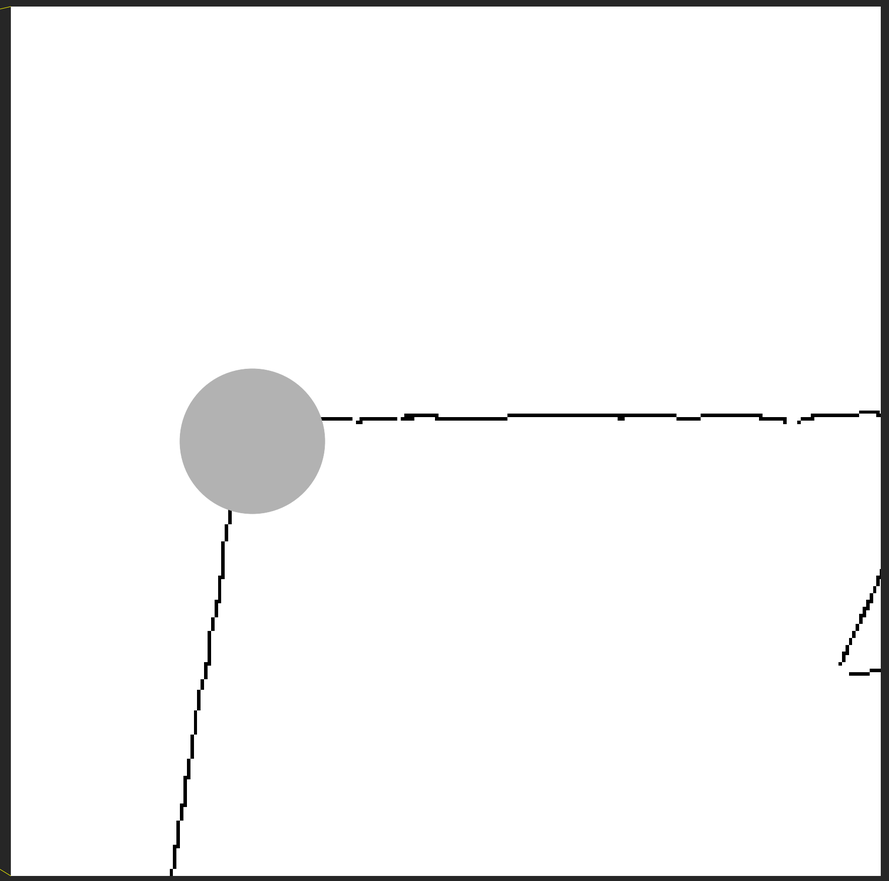




Junction Detection

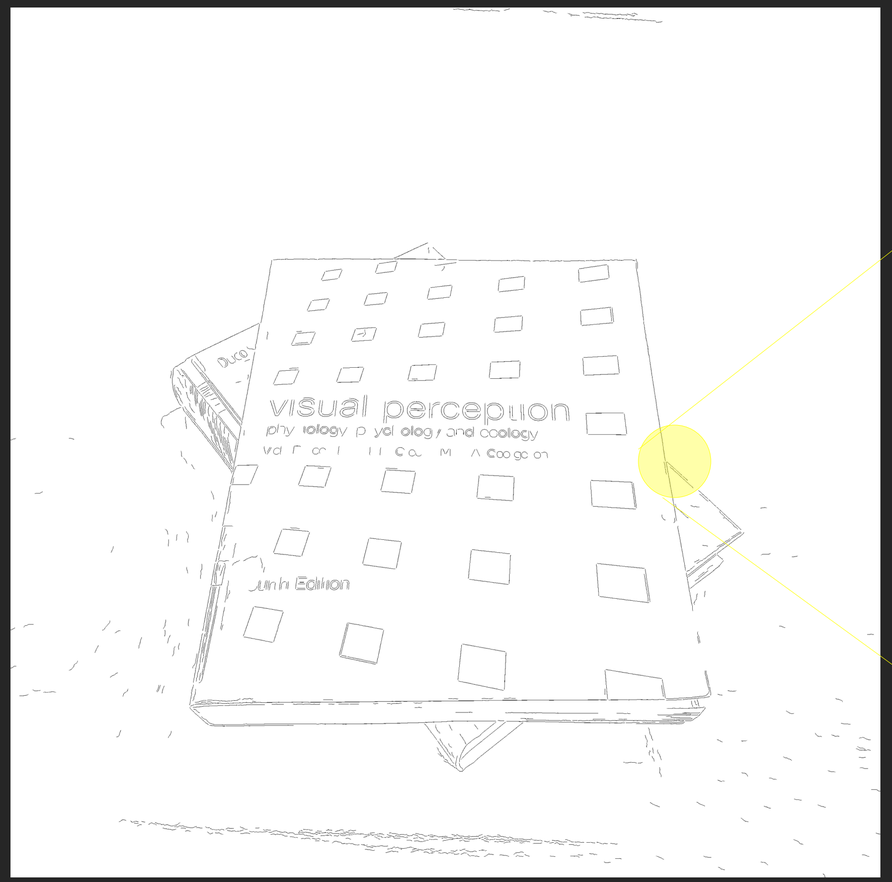
Basic Terminology & Motivation

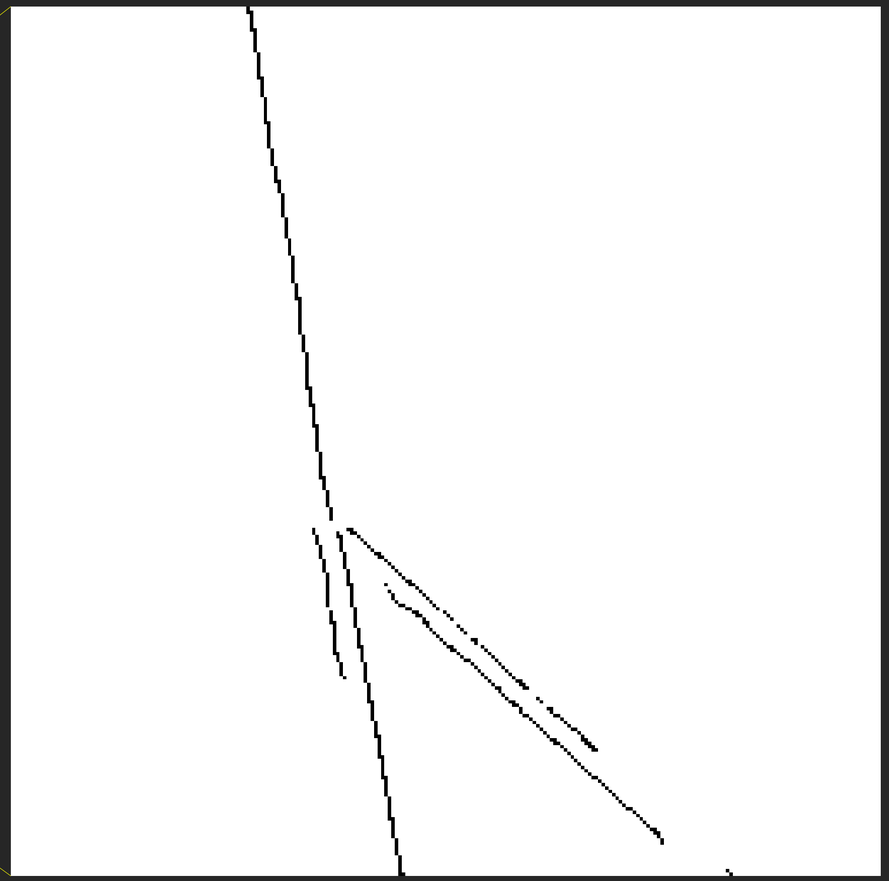




Junction Detection

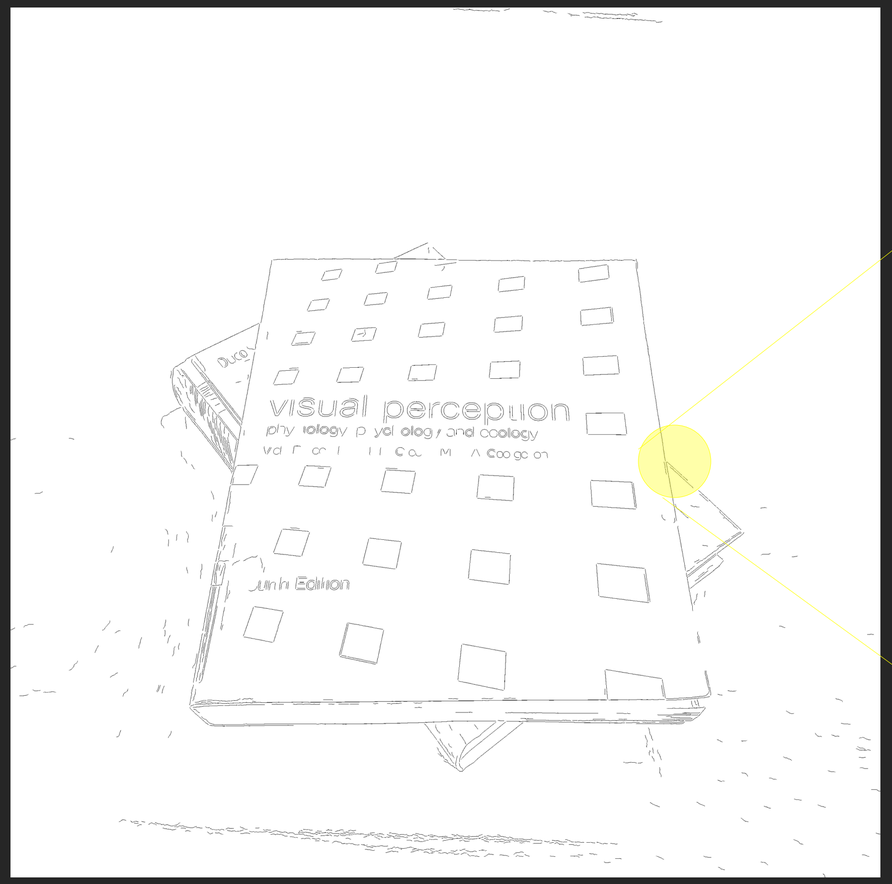
Basic Terminology & Motivation

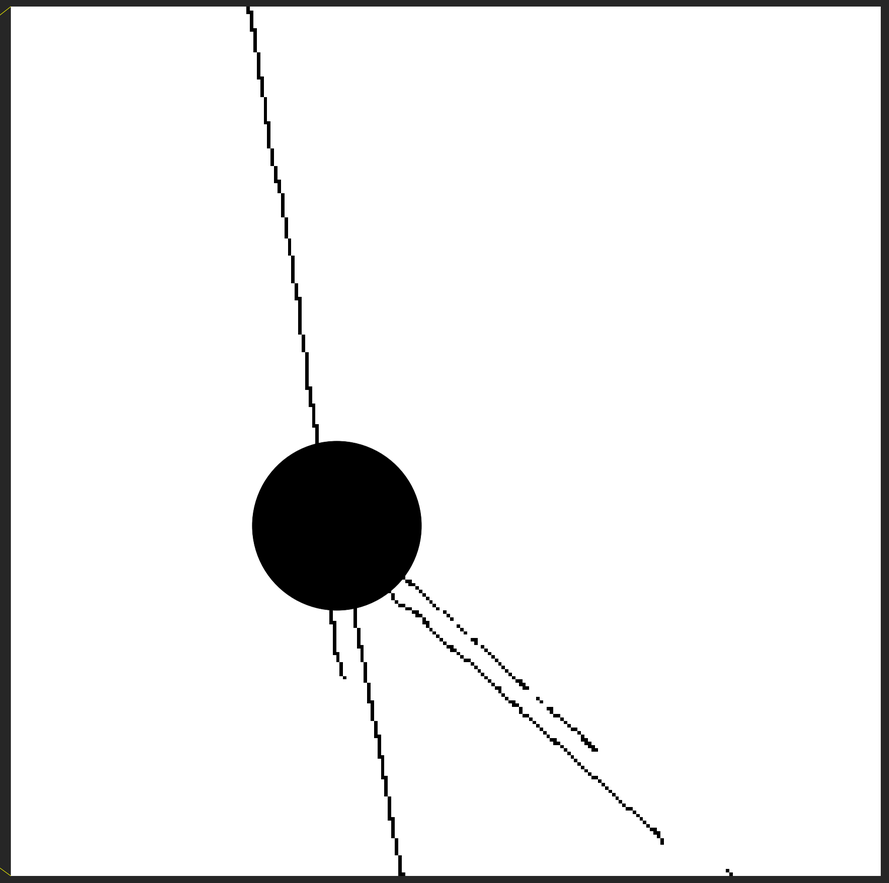




Junction Detection

Basic Terminology & Motivation





Python Setup

Methods

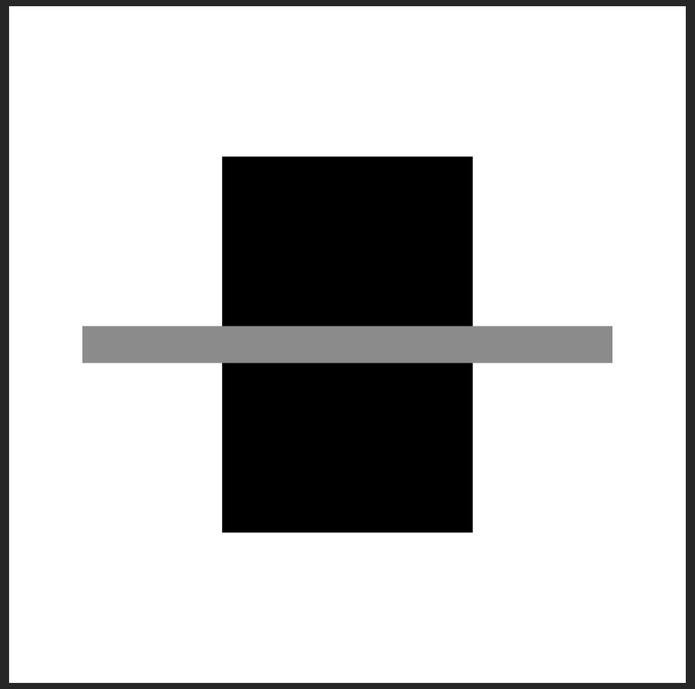
- OpenCV for reading images and grey-scale conversion
- Stimupy for creating narrowband noise
- Subprocess to run c++ code via python
- Matplotlib to create plots

Stimuli

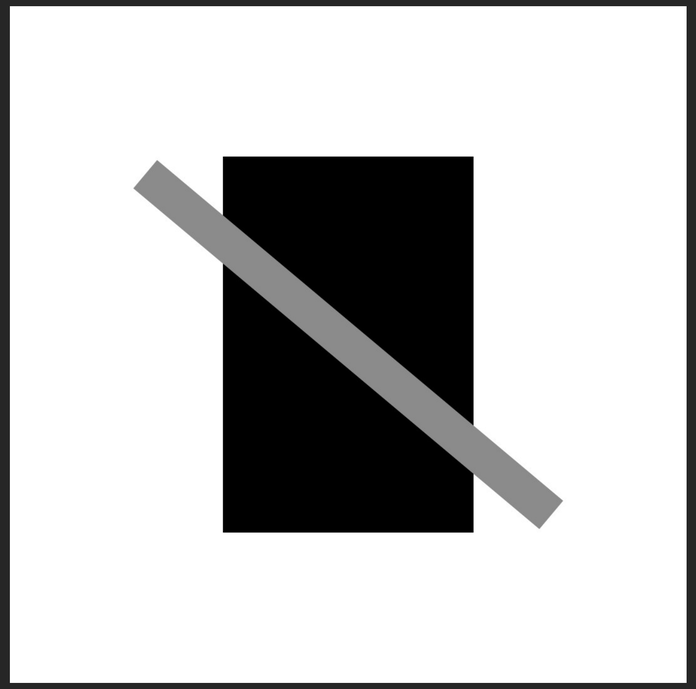
Methods

Stimuli

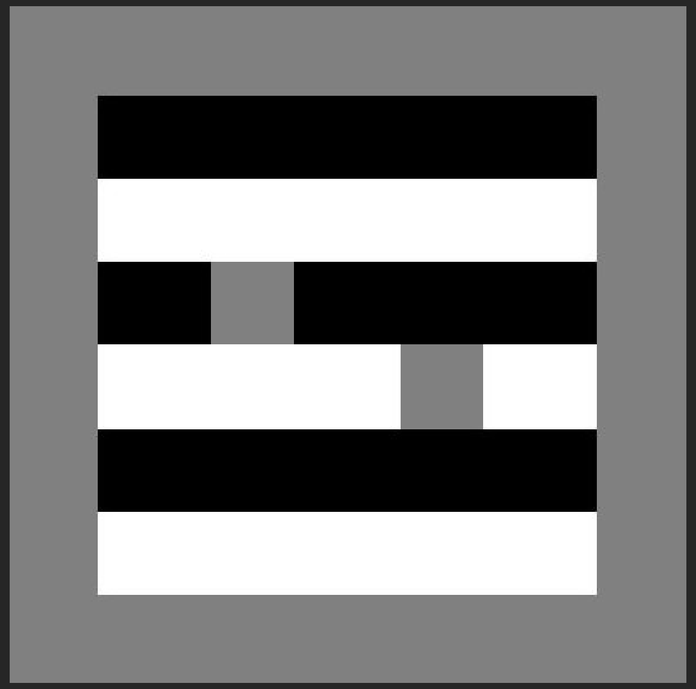
Methods



Bar-Stimulus #1



Bar-Stimulus #2

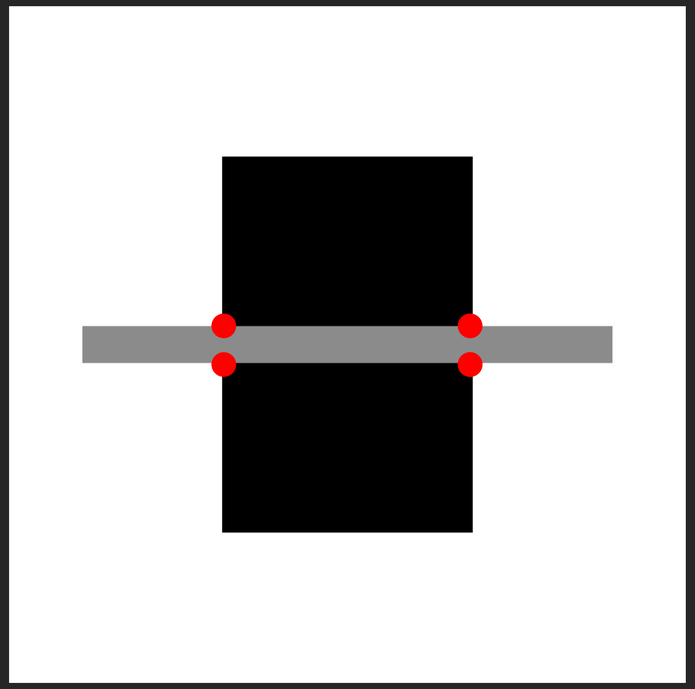


Whites Illusion[1]

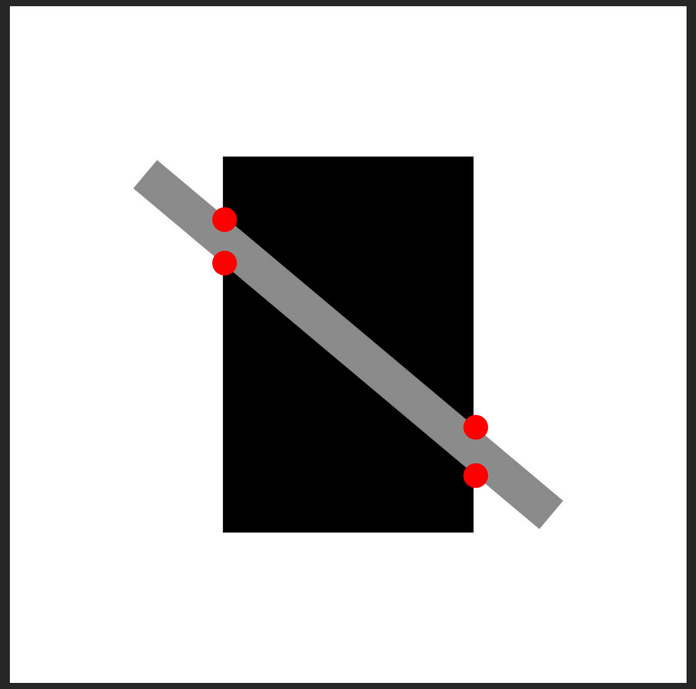
1: Betz et al. 2015, https://doi.org/10.1167/15.14.1

Base Images as Input

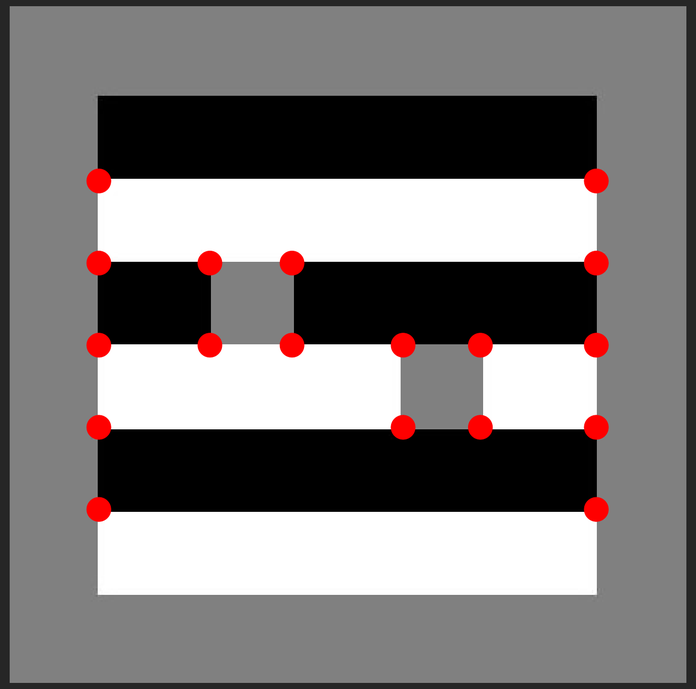
Results



4 T-Junctions

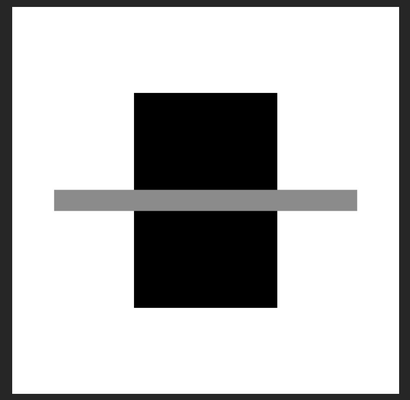


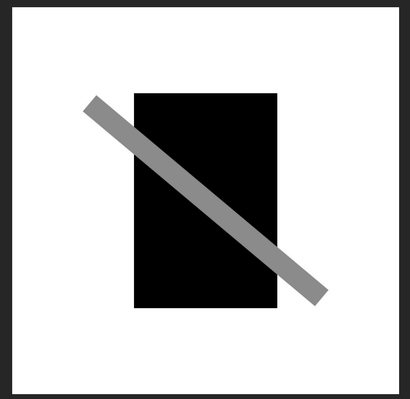
4 T-Junctions

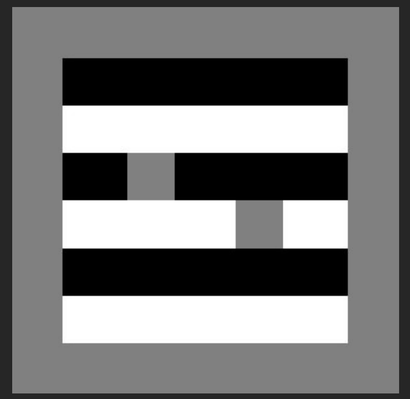


18 T-Junctions

1: Betz et al. 2015, https://doi.org/10.1167/15.14.1



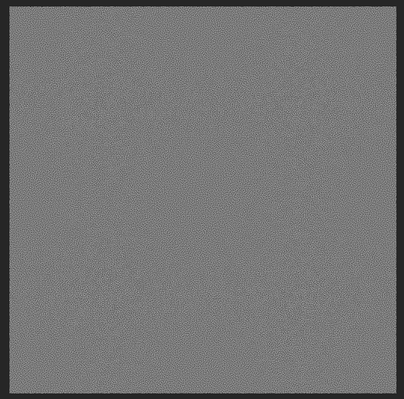




+

Narrowband, 0.005cpd

Narrowband, 0.5cpd



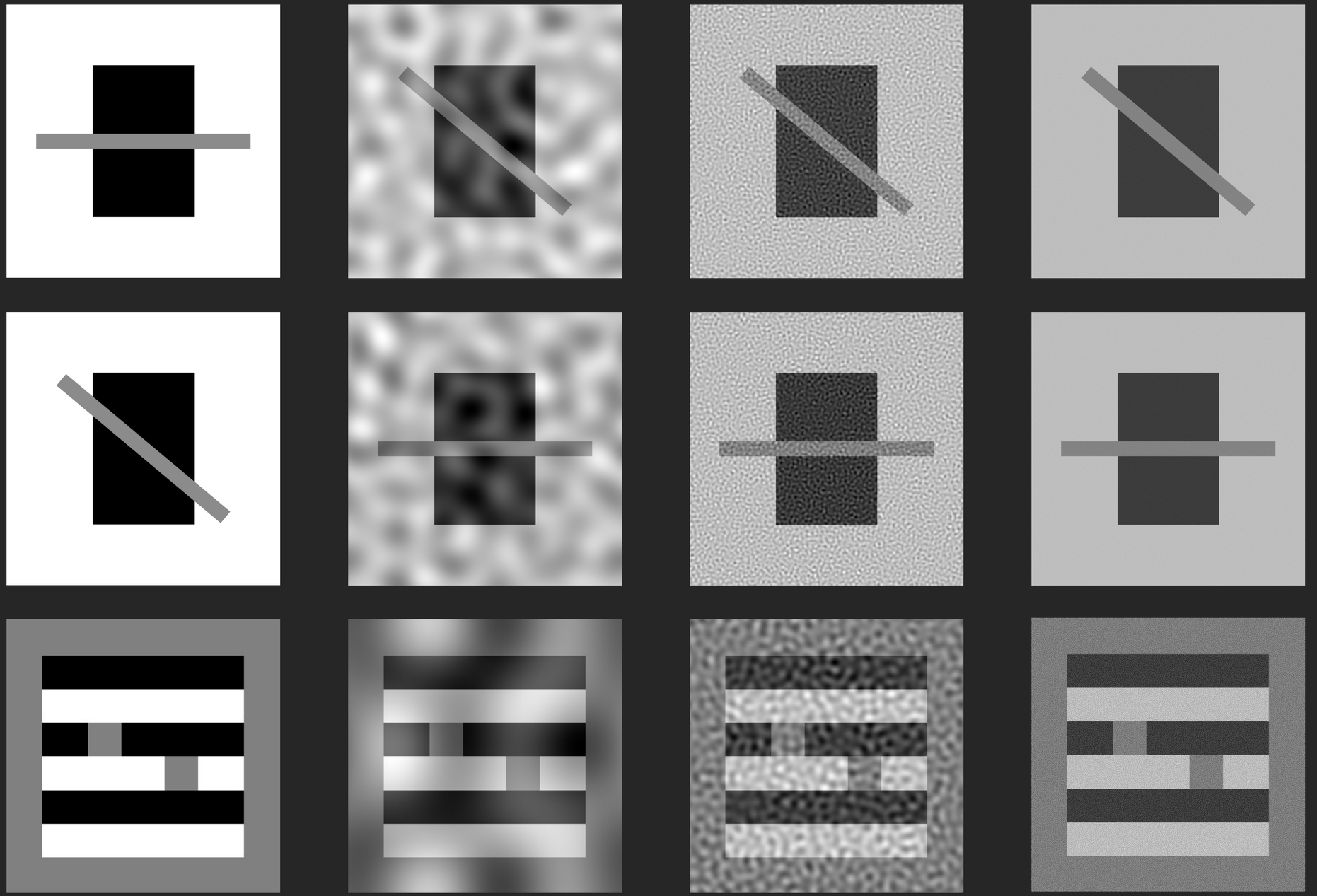
1: Betz et al. 2015, https://doi.org/10.1167/15.14.1

base

0.005cpd

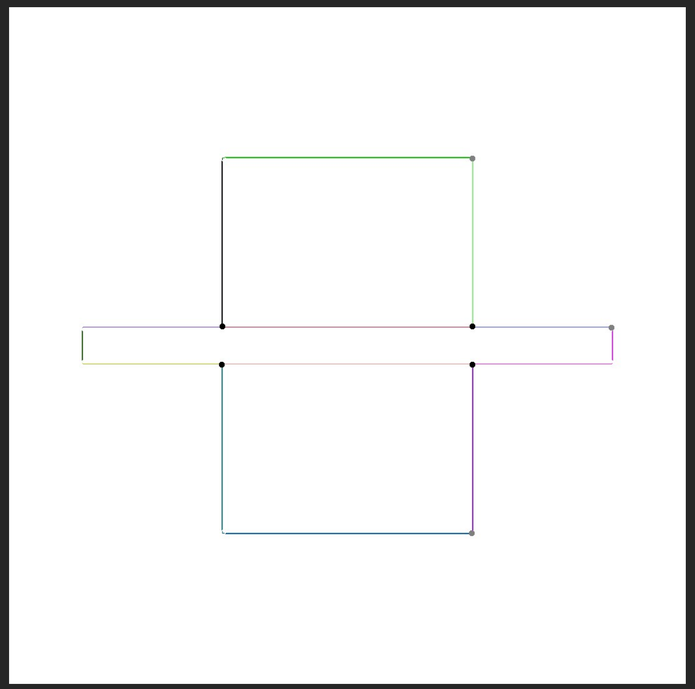
0.05cpd

0.5cpd

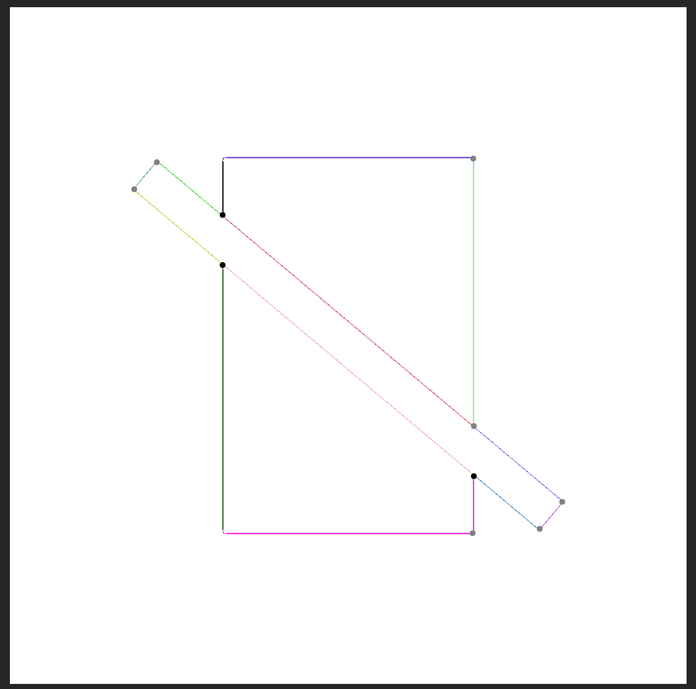


Base Images as Input

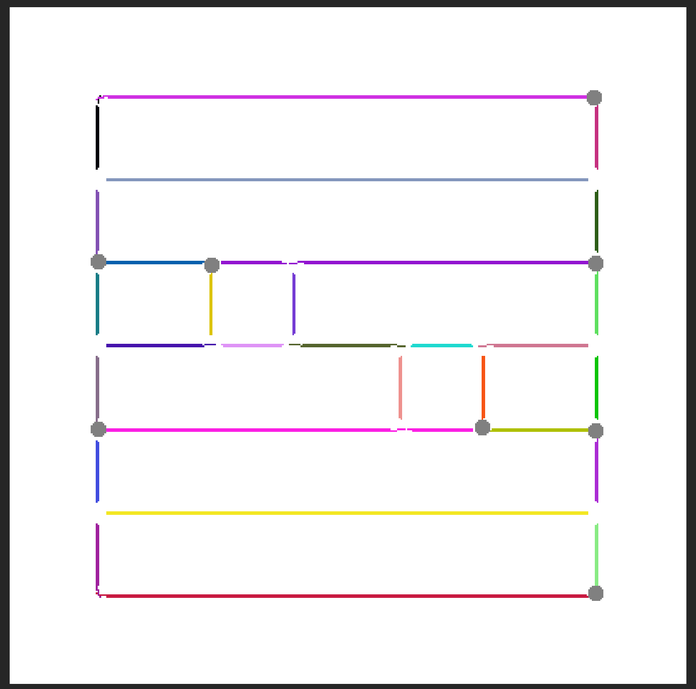
Results



4 T-Junctions



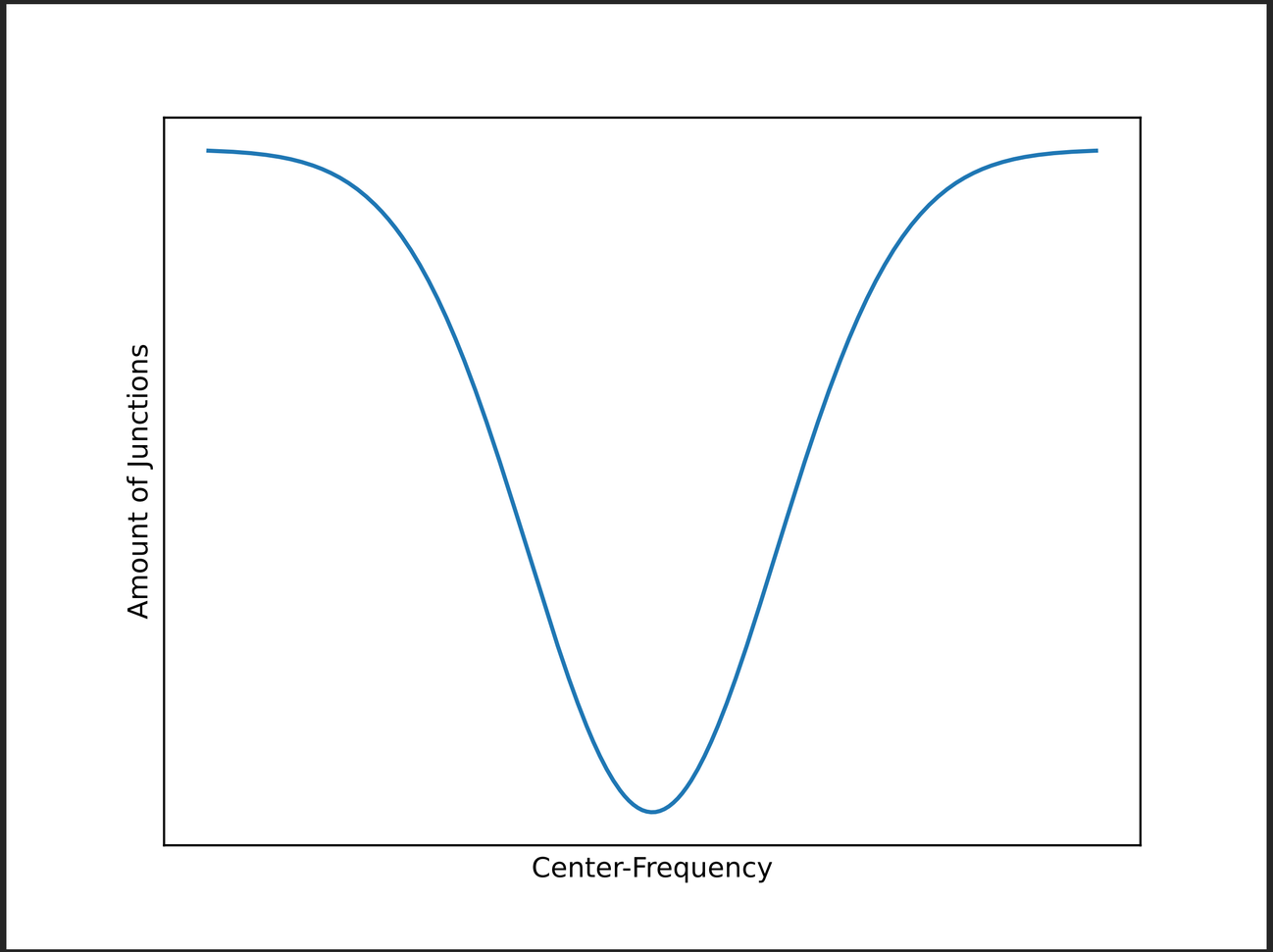
3 T-Junctions



0 T-Junctions

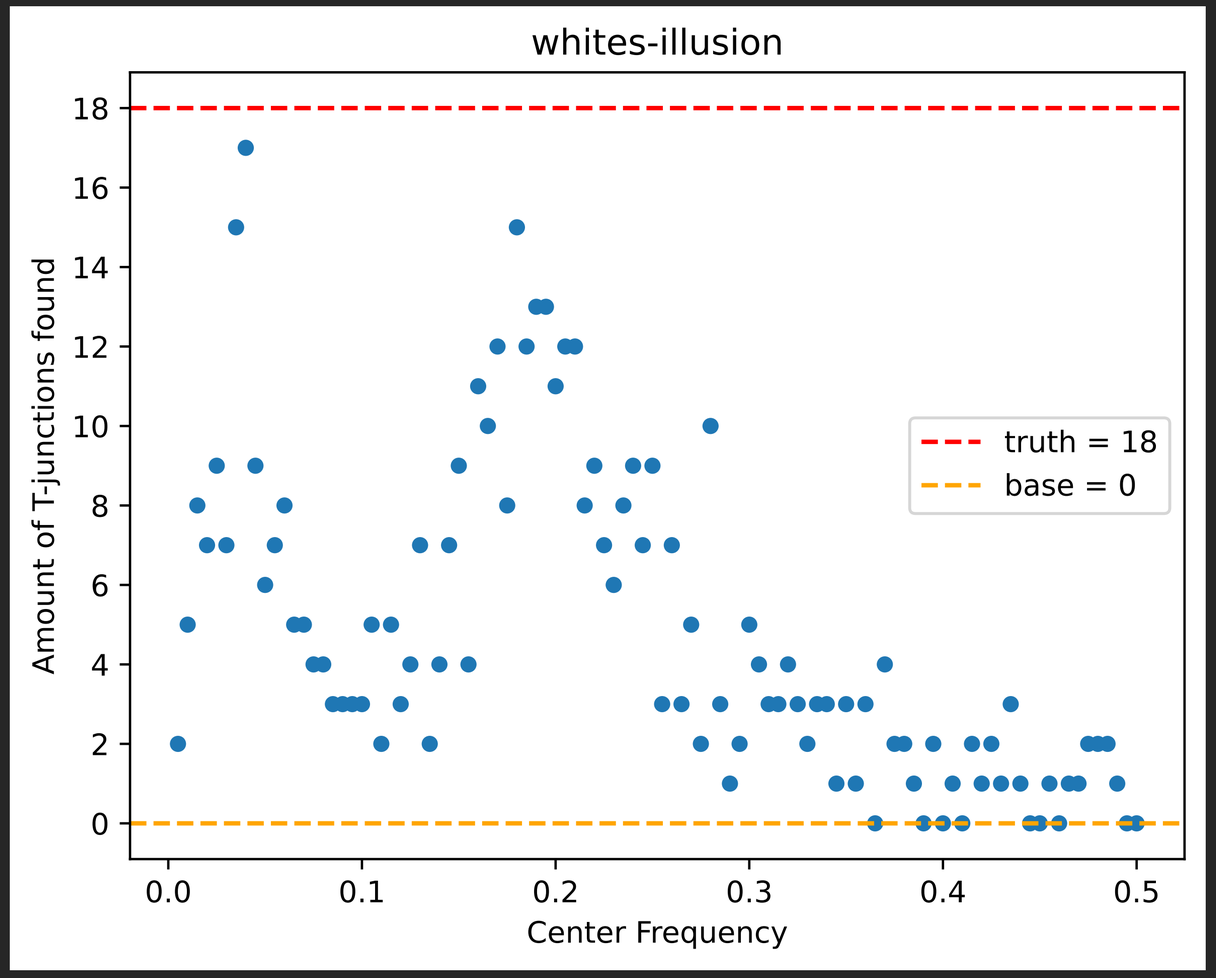
Images with noise

Results



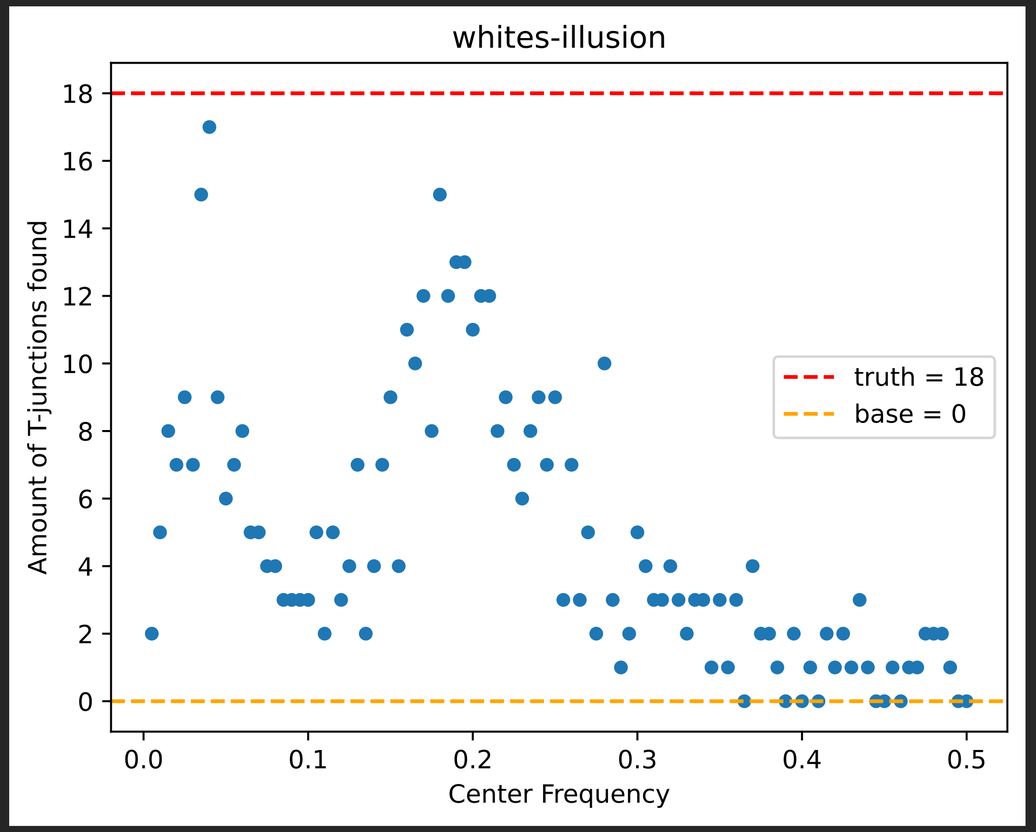
Images with noise

Results

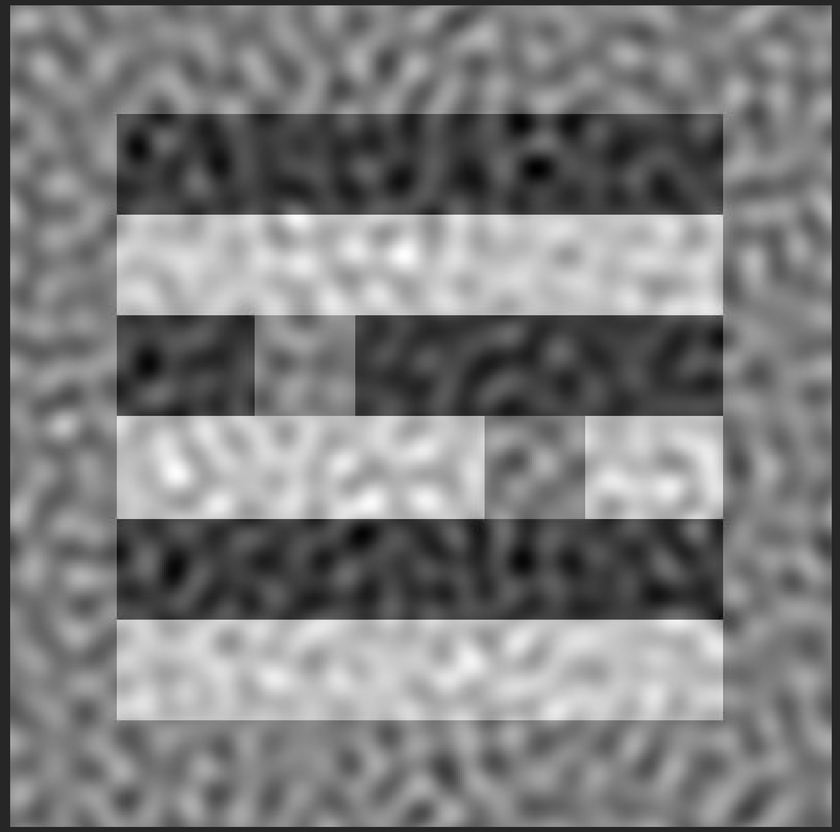


Whites Illusion

Results

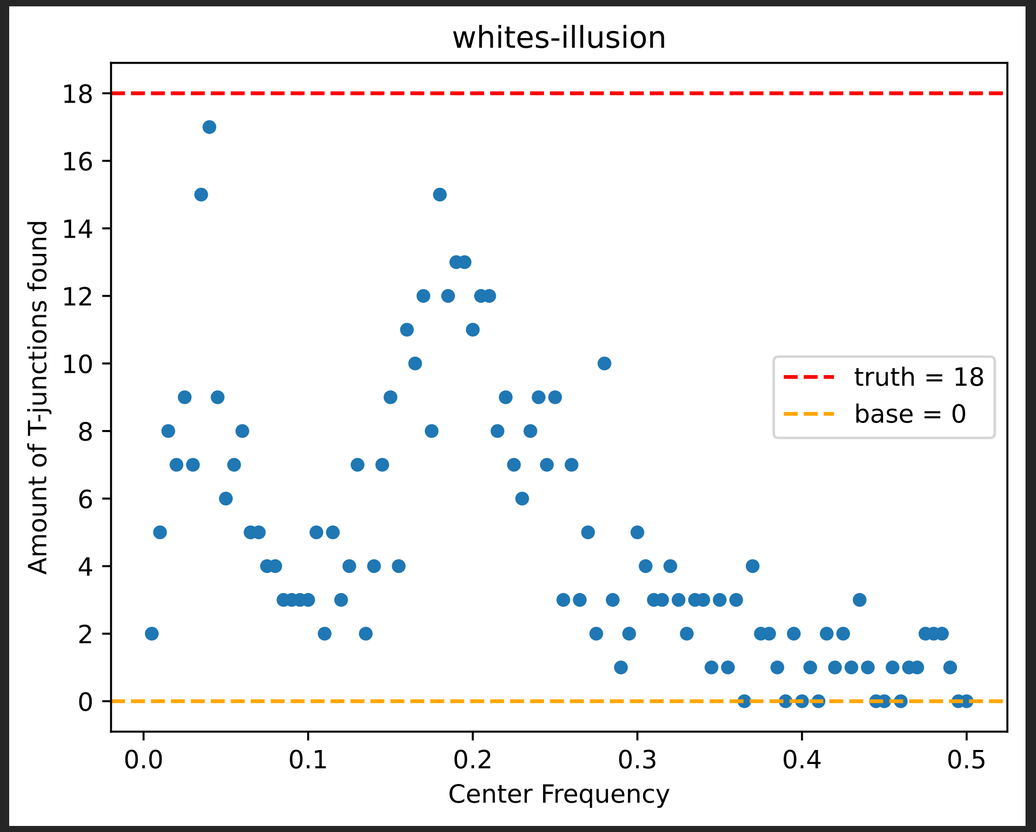


Input at 0.04cpd

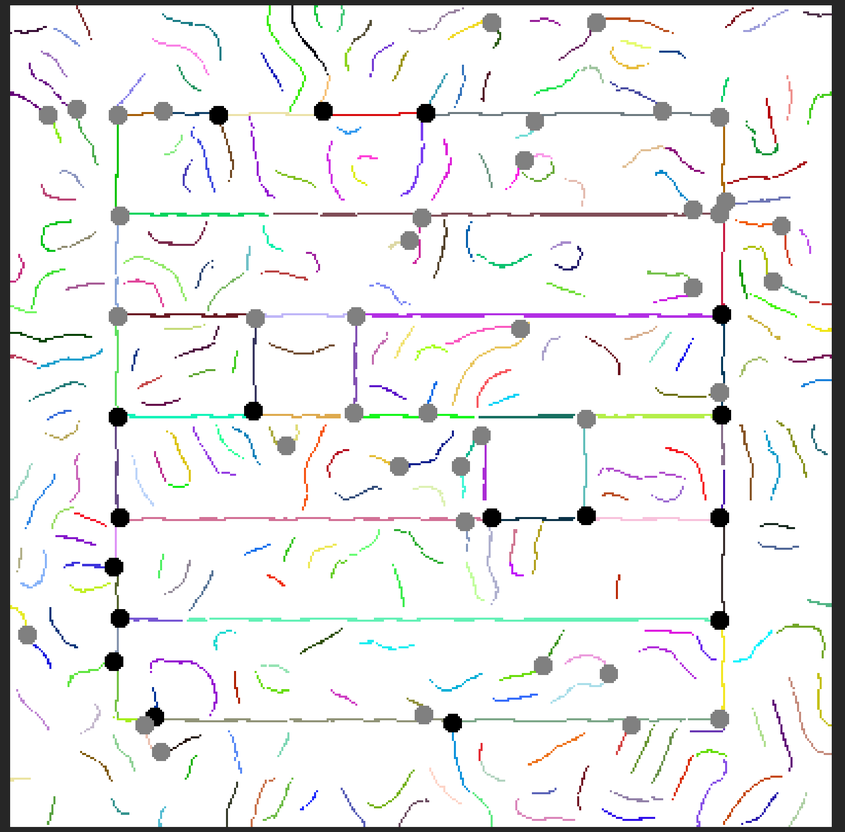


Whites Illusion

Results

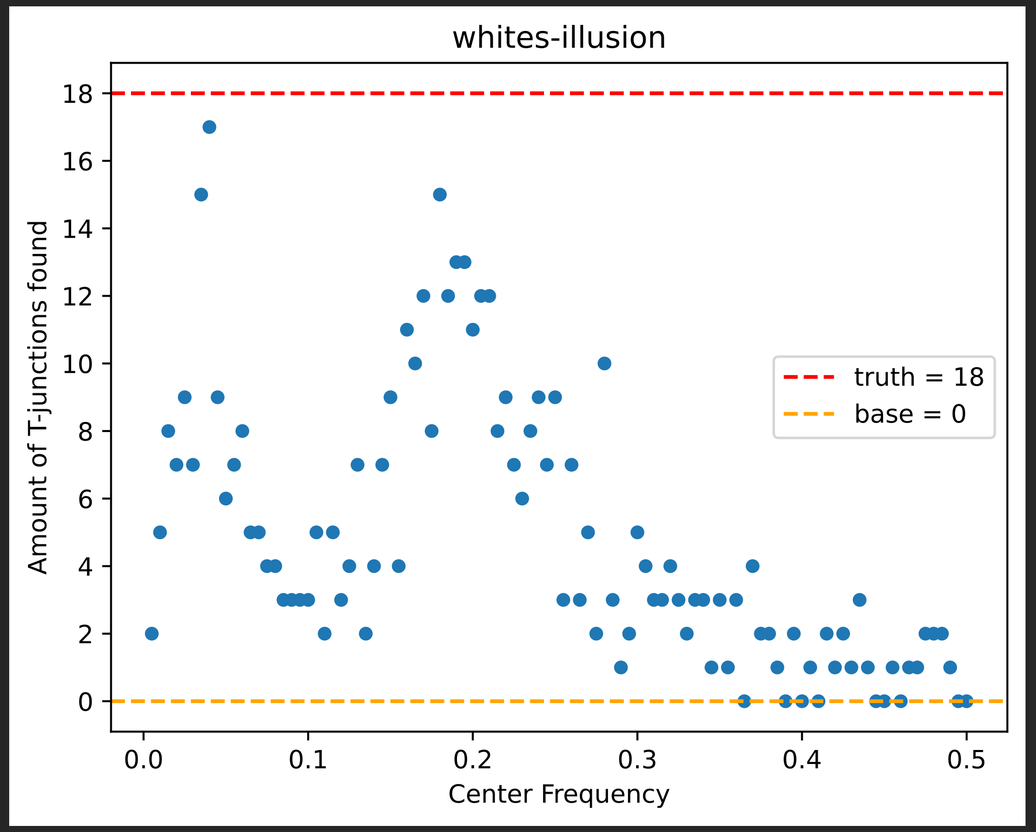


Output at 0.04cpd

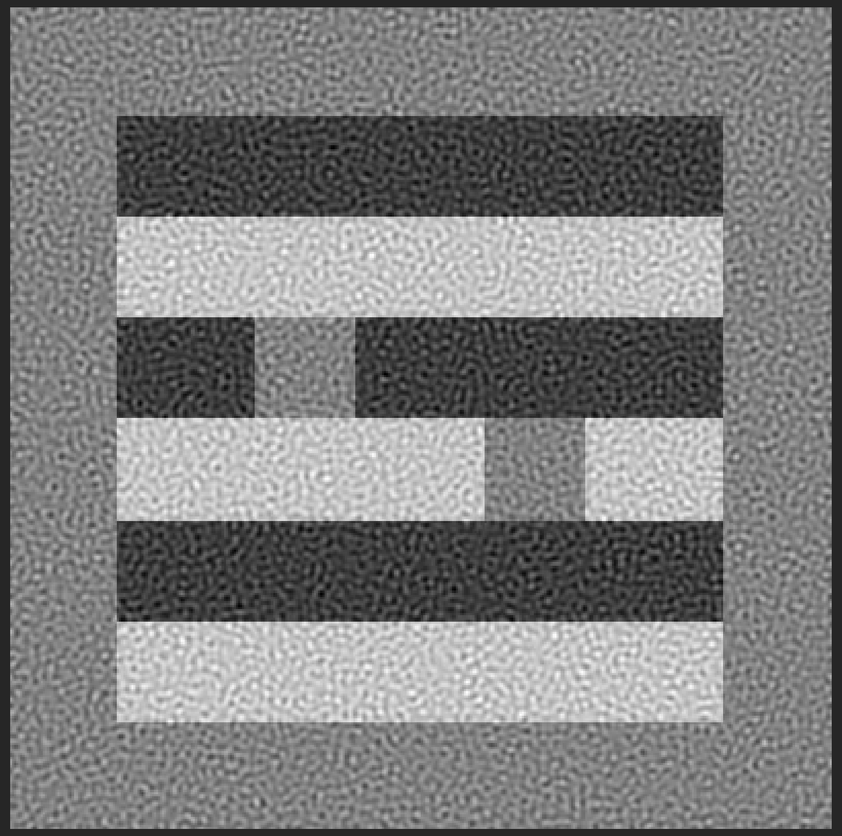


Whites Illusion

Results

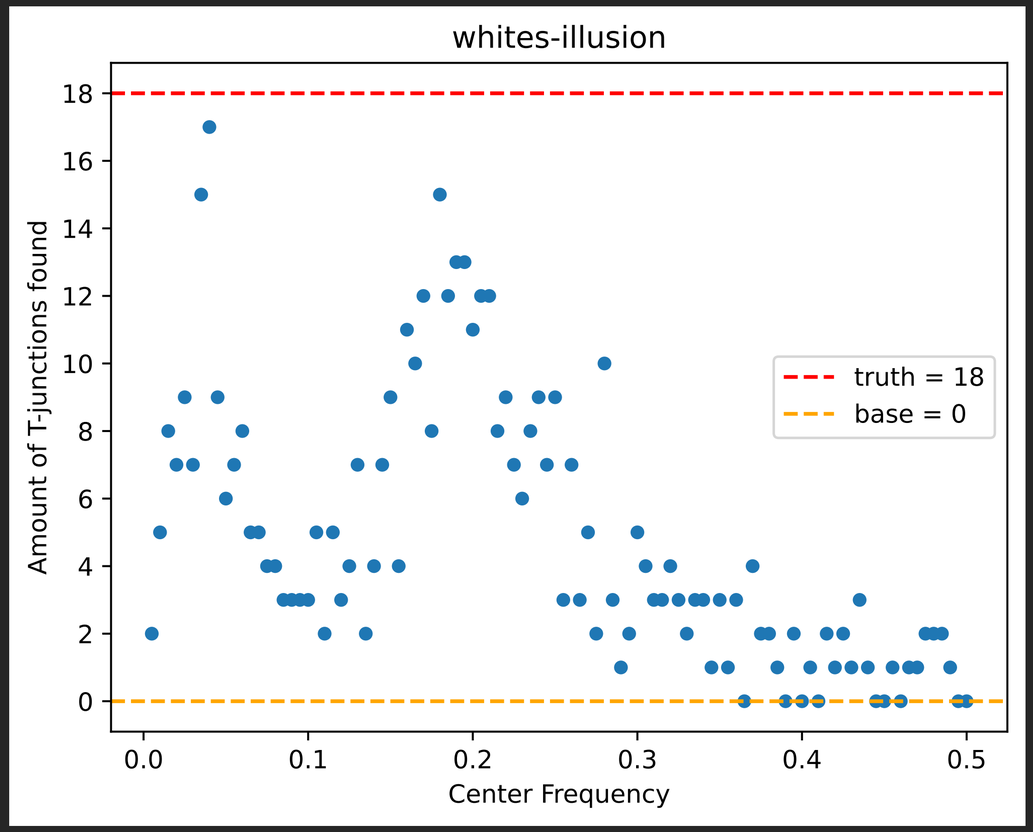


Input at 0.18cpd

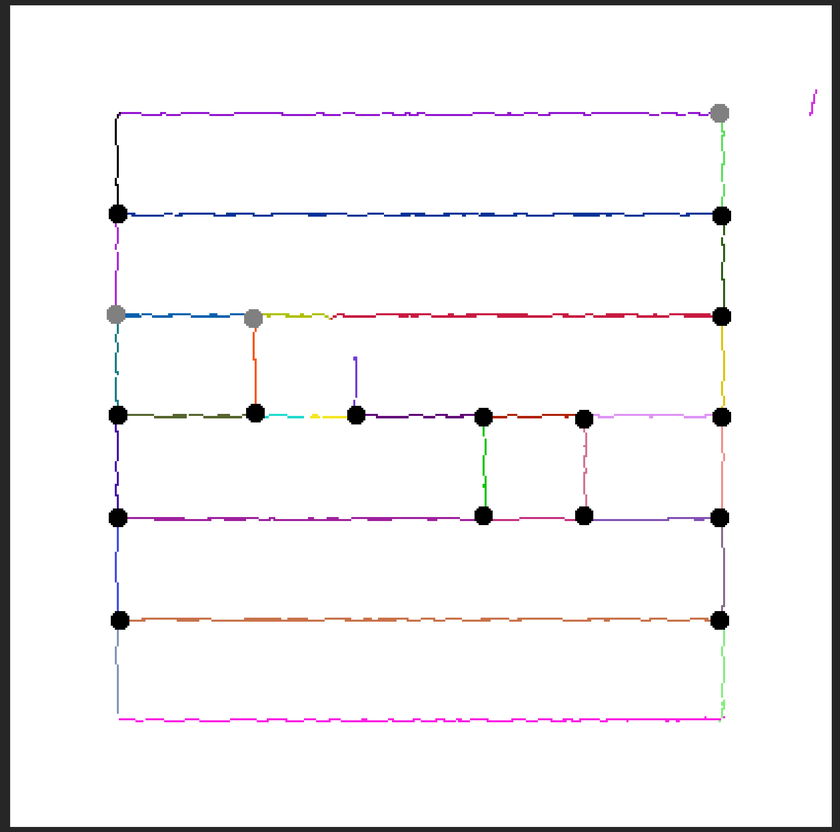


Whites Illusion

Results



Output at 0.18cpd



Criticism and Difficulties

Future Work, Criticism and Difficulties

- Unprecise explanation of the algorithm → I needed a lot of time to understand what it does in order to explain it properly
- Questionable coding style → hard to read and understand
- No accessible codebase from other papers!
- Results that were unsatisfying for me, led to work that was not related to my thesis

Future Work

Future Work, Criticism and Difficulties

- Detection of T-Junctions was worse in scenarios without noise → why?
- Tuning the program to work best in no-noise scenarios → Test again
- Test different noise types (white noise etc.)
- Implement a different approach

Thank you !

Please ask Questions!

base	0.005cpd	0.05cpd	0.5cpd