



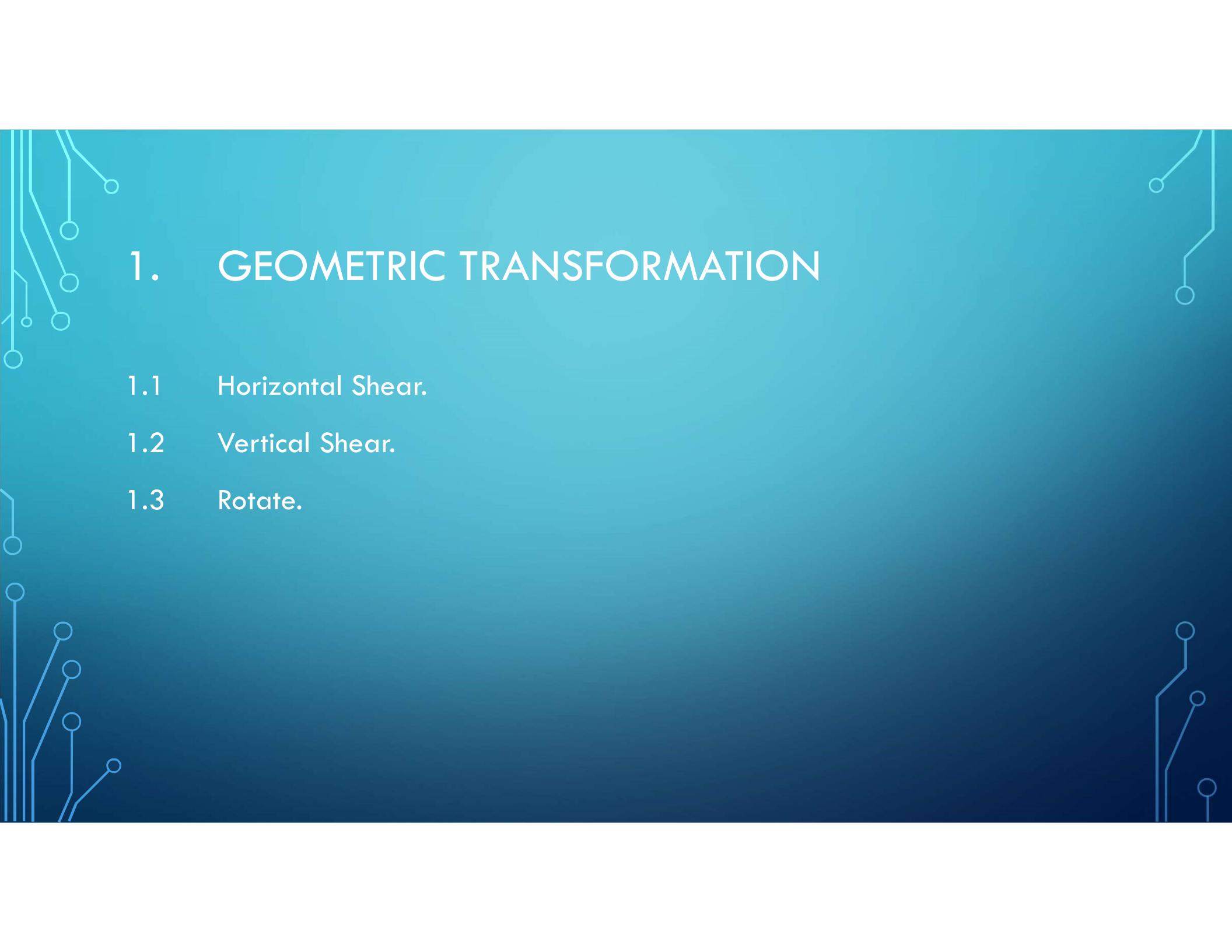
DIGITAL IMAGE PROCESSING

ECE 5690 FALL 2017
FINAL PROJECT PRESENTATION

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GD4139

INDEX

1. Geometric Transformation.
2. Intensity Transformations.
3. Advanced Intensity Transformations.
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5. Advanced Spatial Filtering.
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7. Frequency Domain Analysis (Continued).
8. Noise Reduction.
9. Problem Solution.

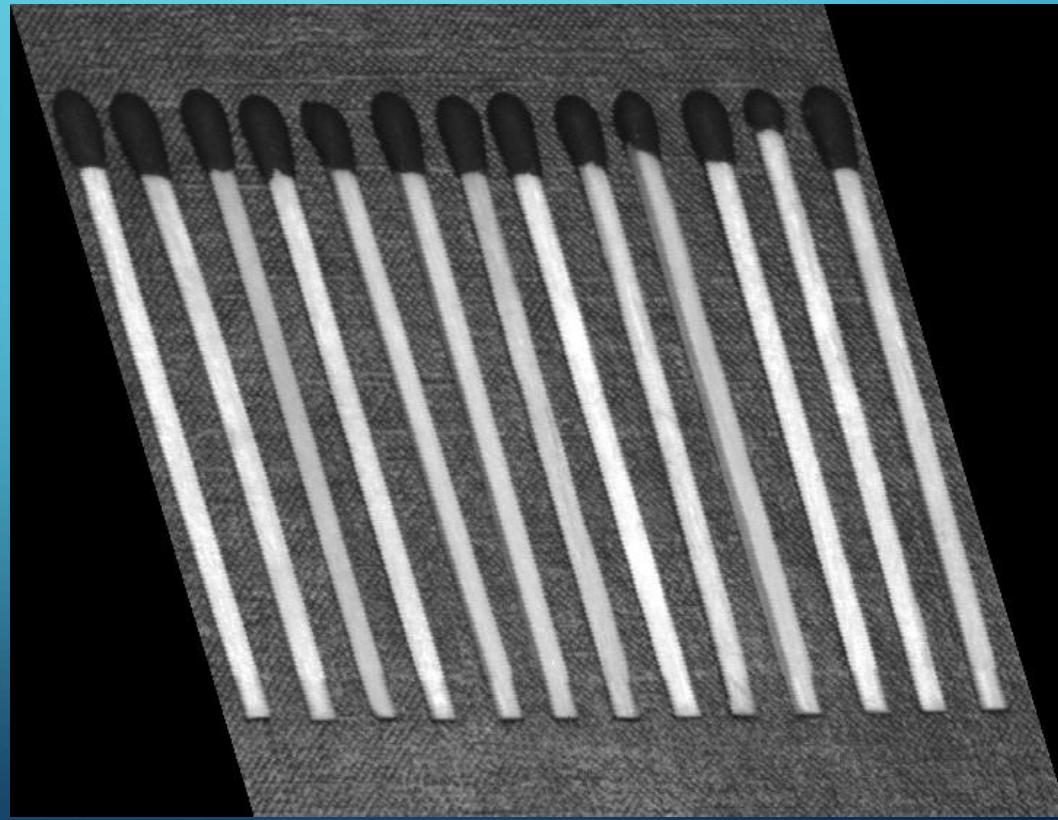
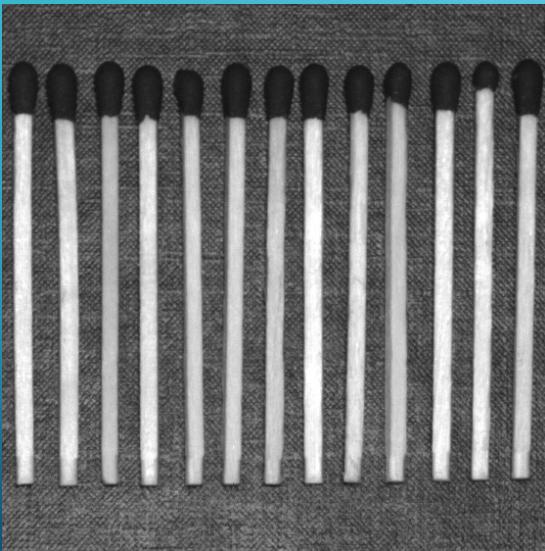


1. GEOMETRIC TRANSFORMATION

- 1.1 Horizontal Shear.
- 1.2 Vertical Shear.
- 1.3 Rotate.

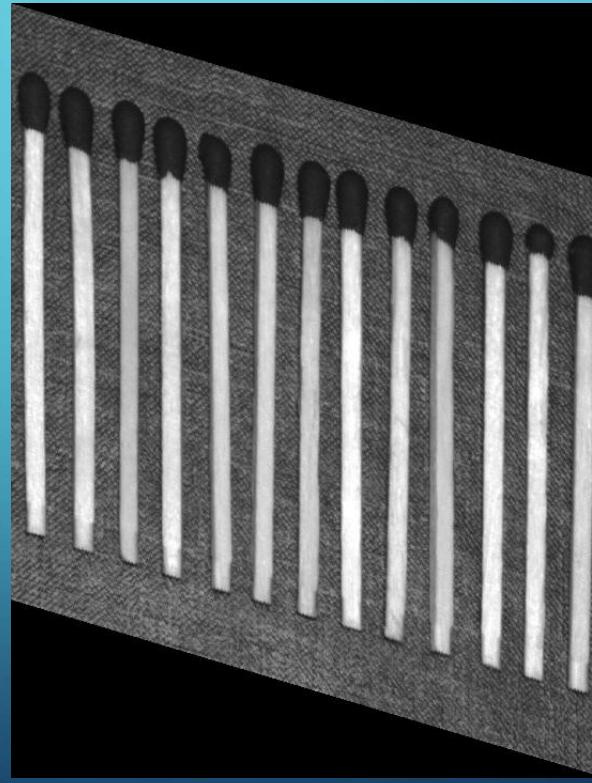
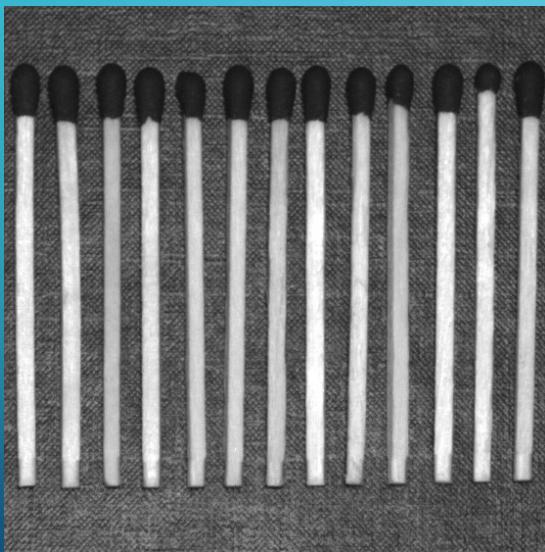
1.1 HORIZONTAL SHEAR

Horizontal shear with Shear Factor 0.3



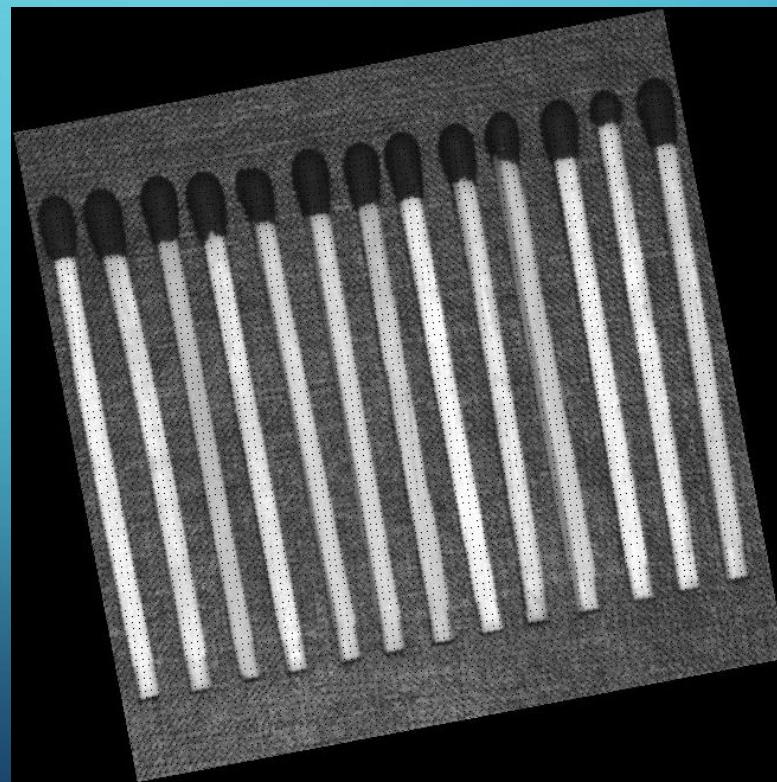
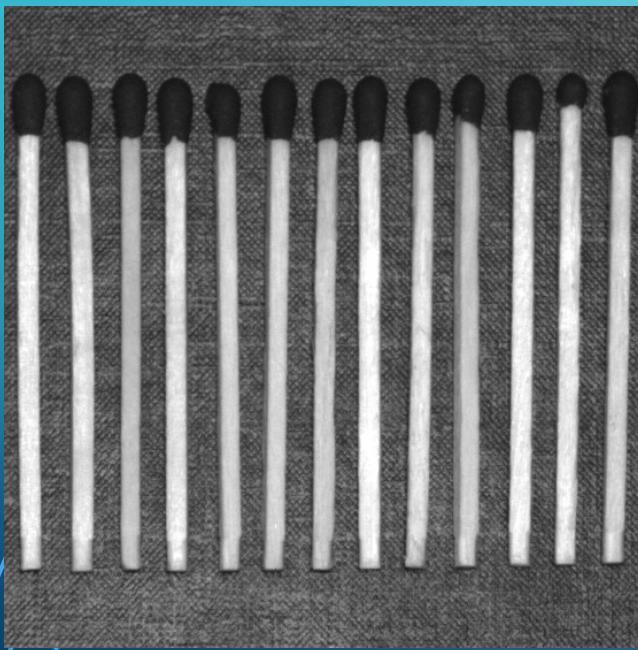
1.2 VERTICAL SHEAR

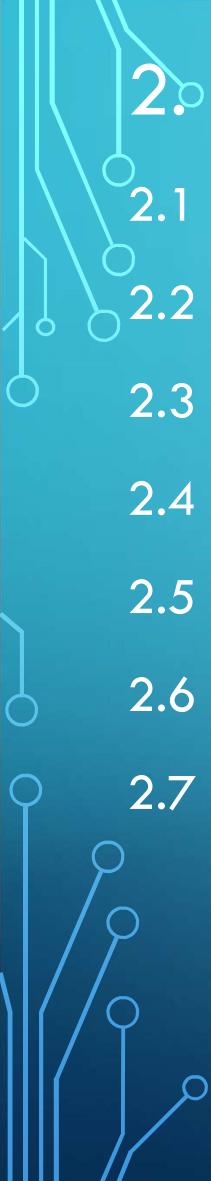
Vertical shear with Shear Factor 0.3



1.3 ROTATE

Image Rotated by 10.8 Degrees.





2.

INTENSITY TRANSFORMATIONS

- 2.1 Image Brightness.
 - 2.2 Contrast Stretch
 - 2.3 Image Negatives
 - 2.4 Image Thresholding
 - 2.5 Intensity Boost
 - 2.6 Intensity Pass
 - 2.7 Image Blending
- 

2.1 BRIGHTNESS

ORIGINAL IMAGE

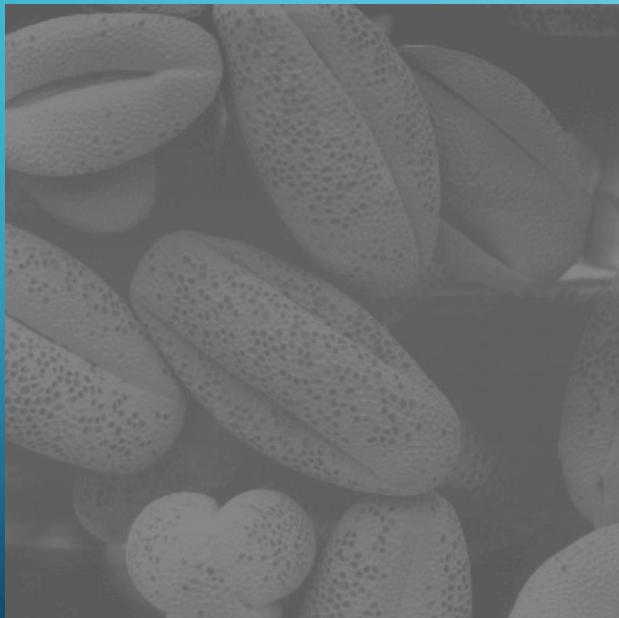


BRIGHTNESS INTENSITY : 80

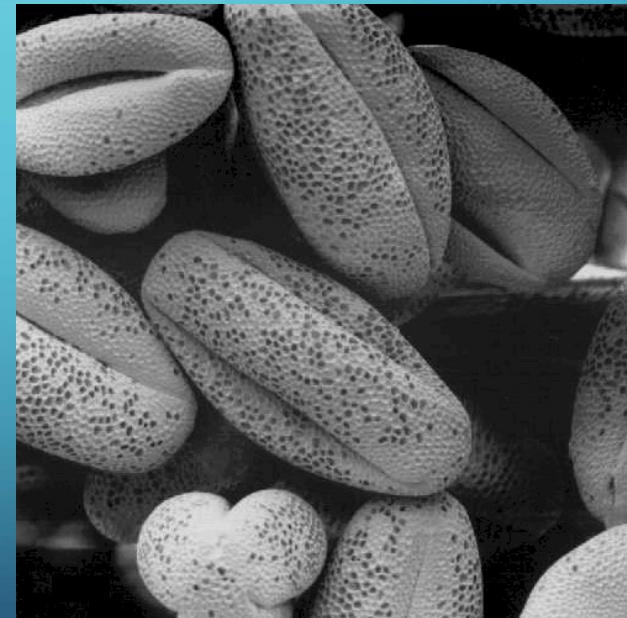


2.2 CONTRAST STRETCH

ORIGINAL IMAGE



CONTRAST STRETCHING EFFECT



2.3 IMAGE NEGATIVE

ORIGINAL IMAGE



NEGATIVE



2.4 THRESHOLDING

ORIGINAL IMAGE



THRESHOLDING INTENSITY: 100



2.5 INTENSITY BOOST

ORIGINAL IMAGE



LOW INTENSITY: 150

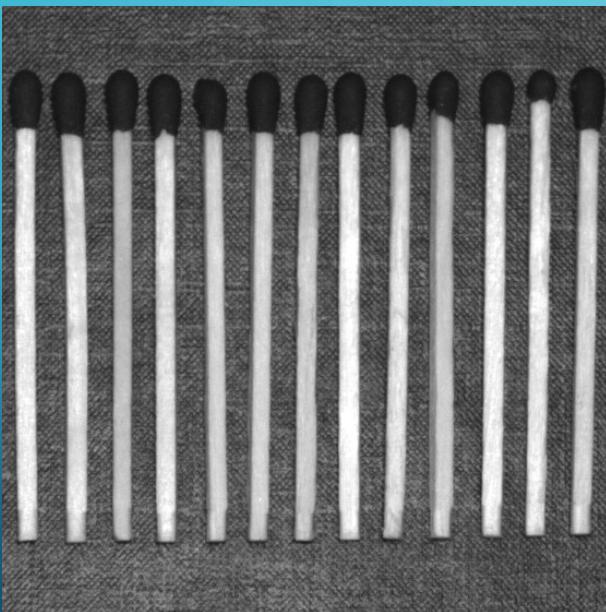
HIGH INTENSITY: 180

BOOST LEVEL: 240

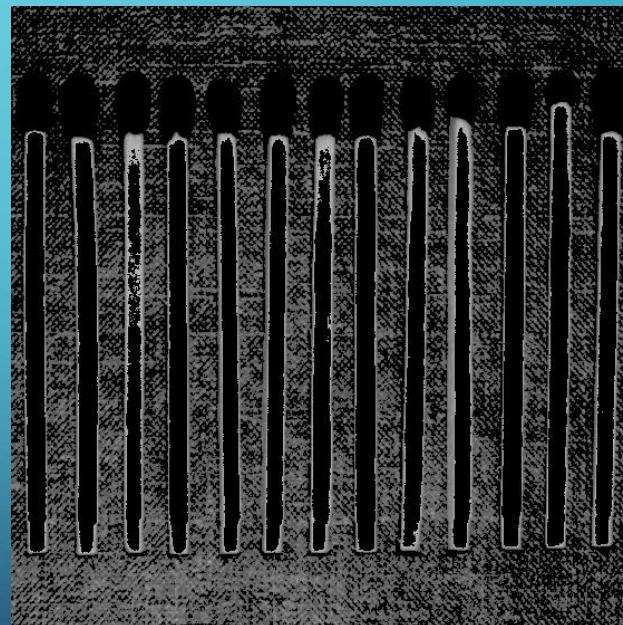


2.6 INTENSITY PASS

ORIGINAL IMAGE



INTENSITY BAND: 80-100



2.7 IMAGE BLENDING

ORIGINAL IMAGES



BLENDED WITH BLEND FACTOR: 0.6



3.

ADVANCED INTENSITY TRANSFORMS

- 3.1 Power Transform
- 3.2 Log Transform
- 3.3 Bit-plane Slicing

3.1 POWER TRANSFORM

ORIGINAL IMAGE



TRANSFORMED IMAGE WITH
CONSTANT K = 1.25 &
GAMMA = 1.05



3.2 LOG TRANSFORM

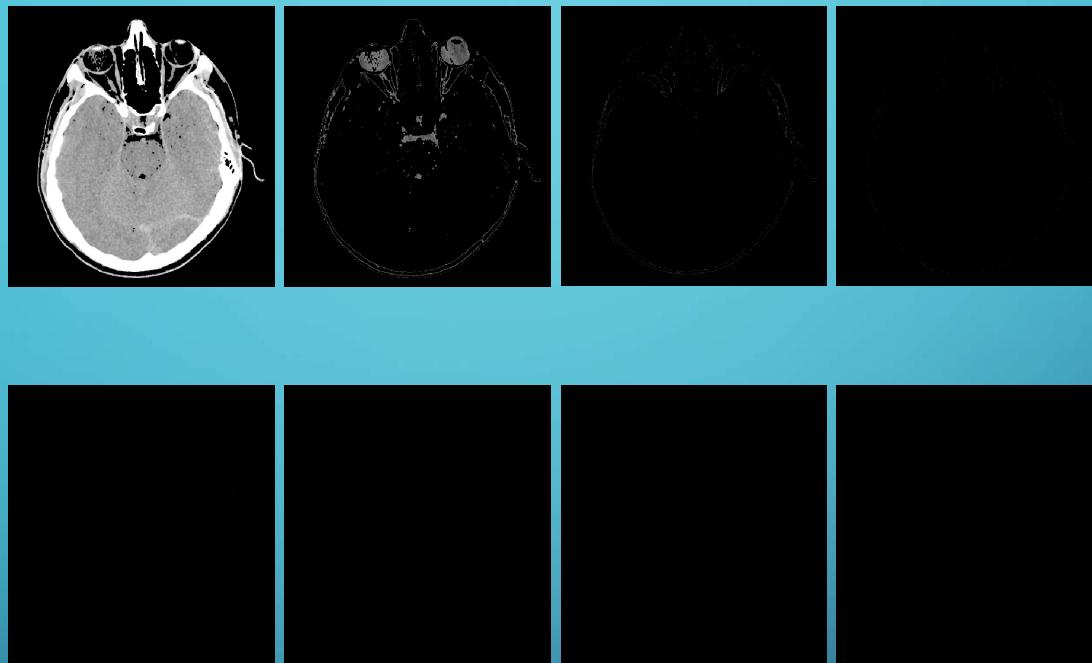
ORIGINAL IMAGE



LOG TRANSFORM WITH
CONSTANT K = 55



3.3 BIT-PLANE SLICING



4. SPATIAL FILTERING

4.1 Histogram

4.1.1 Histogram Estimation

4.1.2 Histogram Equalization

4.2 Smoothing

4.2.1 Box Kernels

4.2.2 Gaussian Kernels

4.3 Sharpening

4.3.1 Laplacian Kernel

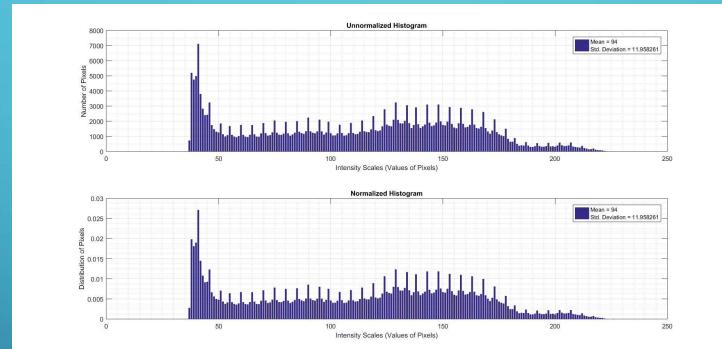
4.3.2 Unsharp Masking

4.1 HISTOGRAM

ORIGINAL IMAGE



HISTOGRAM



HISTOGRAM EQUALIZATION



4.2 SMOOTHING

ORIGINAL



5 X 5 BOX



9 X 9 BOX



ORIGINAL



5 X 5 GAUSSIAN
 $K = 2$ SIGMA = 2



9 X 9 GAUSSIAN
 $K = 2$ SIGMA = 2



4.3 SHARPENING

ORIGINAL



3 X 3
LAPLACIAN



UNSHARP
MASKING



5. ADVANCED SPATIAL FILTERING

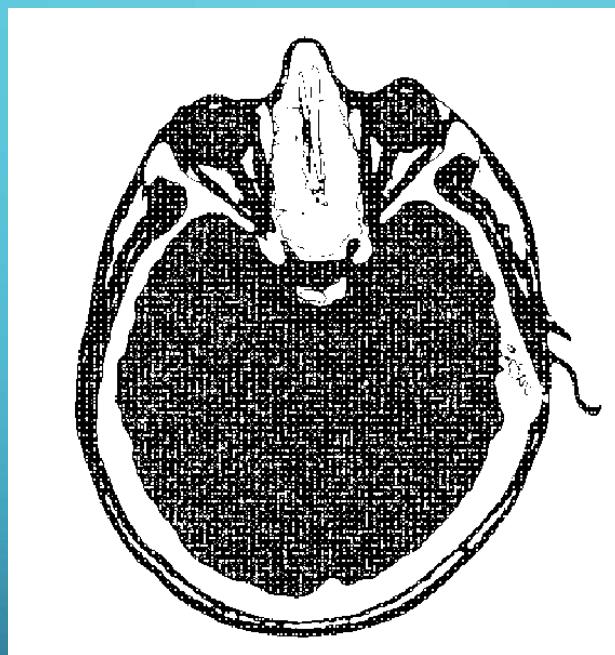
- 5.1 Fuzzy Edge Detection
- 5.2 Sobel Edge Detection

5. ADVANCED SPATIAL FILTERING

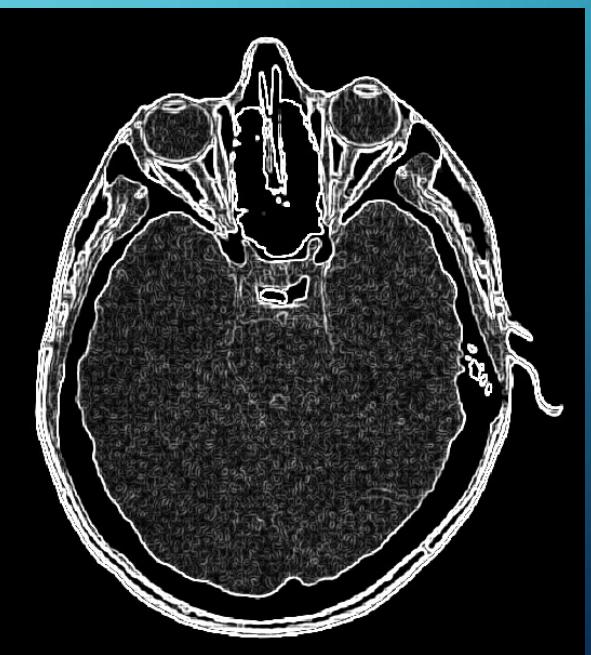
ORIGINAL



FUZZY EDGE
DETECTION



SOBEL EDGE
DETECTION



6. FREQUENCY DOMAIN ANALYSIS

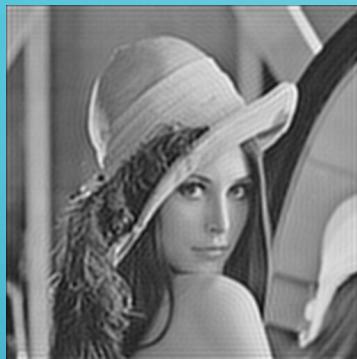
- 6.1 Smoothing
- 6.2 Sharpening
- 6.3 Laplacian
- 6.4 Unsharp Masking
- 6.5 High Boost Filtering
- 6.6 High-frequency-emphasis Filtering
- 6.7 More General High-frequency-emphasis Filtering

6.1 SMOOTHING

ORIGINAL



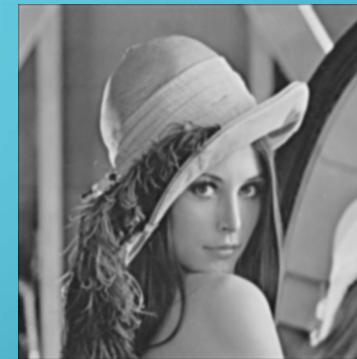
IDEAL WITH
0.25 CUT-OFF



GAUSSIAN WITH
0.25 CUT-OFF



BUTTERWORTH WITH 0.25
CUT-OFF AND ORDER = 02



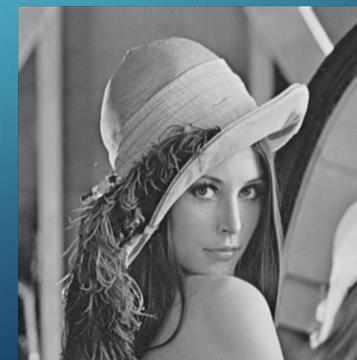
IDEAL WITH
0.5 CUT-OFF



GAUSSIAN WITH
0.5 CUT-OFF



BUTTERWORTH WITH 0.5
CUT-OFF AND ORDER = 03



6.2 SHARPENING

ORIGINAL



IDEAL WITH
0.25 CUT-OFF



GAUSSIAN WITH
0.25 CUT-OFF



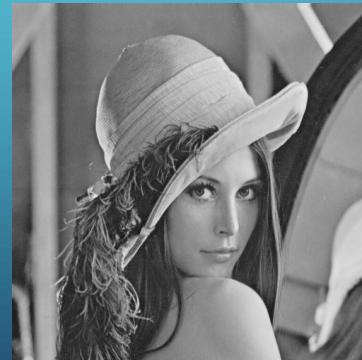
BUTTERWORTH WITH
0.25 CUT-OFF AND
ORDER = 02



IDEAL WITH
0.5 CUT-OFF



GAUSSIAN WITH
0.5 CUT-OFF



BUTTERWORTH WITH 0.5
CUT-OFF AND ORDER = 03



6.3 LAPLACIAN

ORIGINAL IMAGE



LAPLACIAN



6.4 UNSHARP MASKING

ORIGINAL IMAGE



UNSHARP MASKING WITH BUTTERWORTH
FILTER, 0.15 CUT-OFF AND ORDER = 2



6.5 HIGH-BOOST FILTERING

ORIGINAL IMAGE



HIGHBOOST FILTERING WITH BUTTERWORTH
FILTER, CUT-OFF = 0.25, ORDER = 2, K = 1.25



6.6 HIGH-FREQUENCY-EMPHASIS FILTERING

ORIGINAL IMAGE



HIGH-FREQUENCY-EMPHASIS FILTERING WITH
BUTTERWORTH, CUT-OFF: 0.3, ORDER:2, K: 4



6.6 MORE GENERAL HIGH-FREQUENCY-EMPHASIS FILTERING

ORIGINAL IMAGE



MORE GENERAL HIGH-FREQUENCY-EMPHASIS FILTERING
WITH GAUSSIAN, CUT-OFF: 0.2, K1: 1.5, K2: 2



7. FREQUENCY DOMAIN ANALYSIS (CONT.)

7.1 Band filtering: Band Pass Filtering

7.2 Band filtering: Band Reject Filtering

7.1 BAND-PASS FILTERING

ORIGINAL IMAGE



BAND PASS FILTERING WITH $C_0 = 0.25$ AND $W = 0.5$



7.2 BAND-REJECT FILTERING

ORIGINAL IMAGE



BAND REJECT FILTERING WITH $C_0 = 0.25$
AND $W = 0.5$



8. NOISE REDUCTION

8.1 Spatial Filtering

8.1.1 Arithmetic Mean Filter

8.1.2 Geometric Mean Filter

8.1.3 Harmonic Mean Filter

8.1.4 Contraharmonic Mean Filter

8.2 Order Statistics Filtering

8.2.1 Median Filter

8.2.2 Max Filter

8.2.3 Min Filter

8.2.4 Midpoint Filter

8.2.5 Alpha-Trimmed Mean Filter

9.1 PROBLEM IMAGE 1

ORIGINAL IMAGE



HARMONIC MEAN FILTER OF SIZE 3 AND
CONTRAST STRETCH

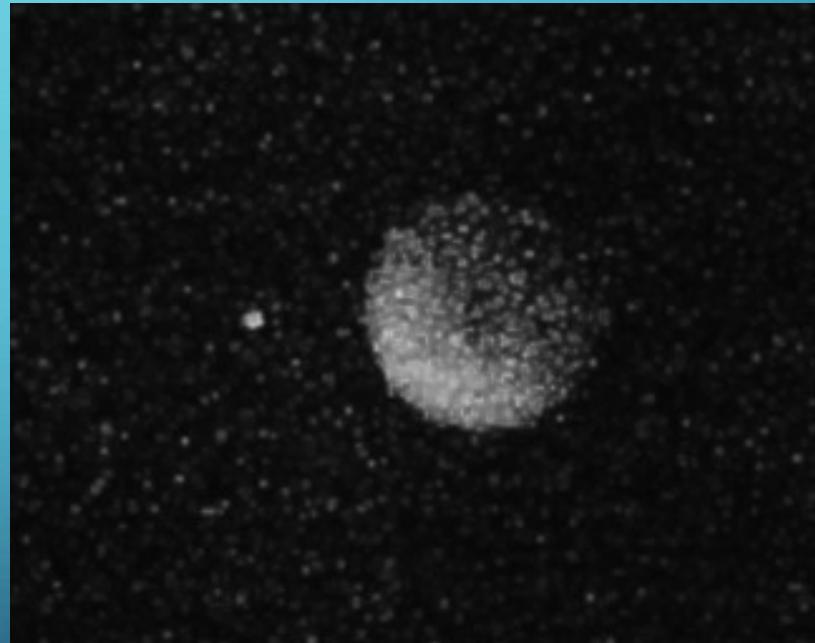


9.2 PROBLEM IMAGE 2

ORIGINAL IMAGE



CONTRAHARMONIC MEAN FILTER OF SIZE 3
AND ORDER -1.5

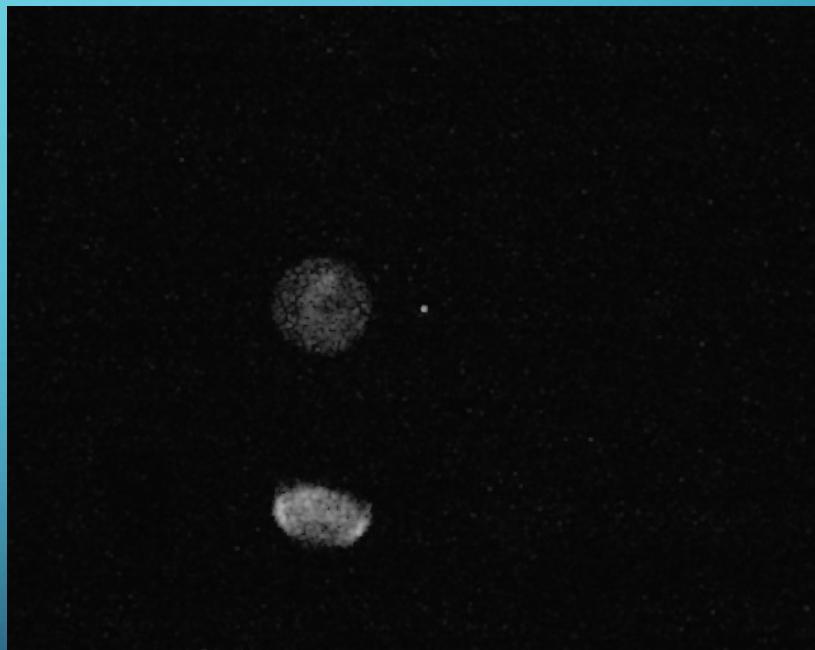


9.3 PROBLEM IMAGE 3

ORIGINAL IMAGE

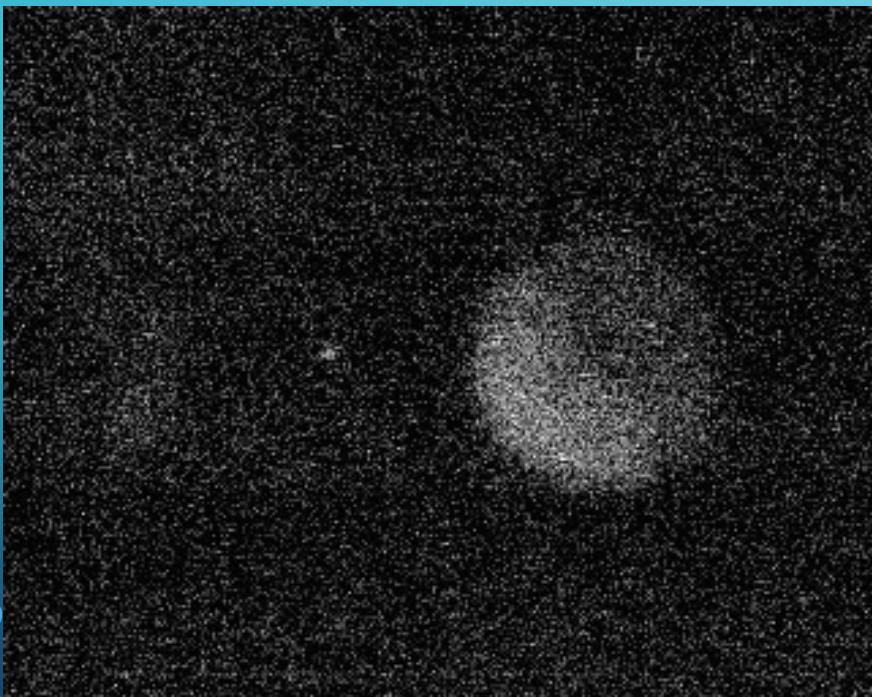


CONTRAHARMONIC MEAN FILTER OF SIZE 3
AND ORDER Q= -1.25, Q= 1.25

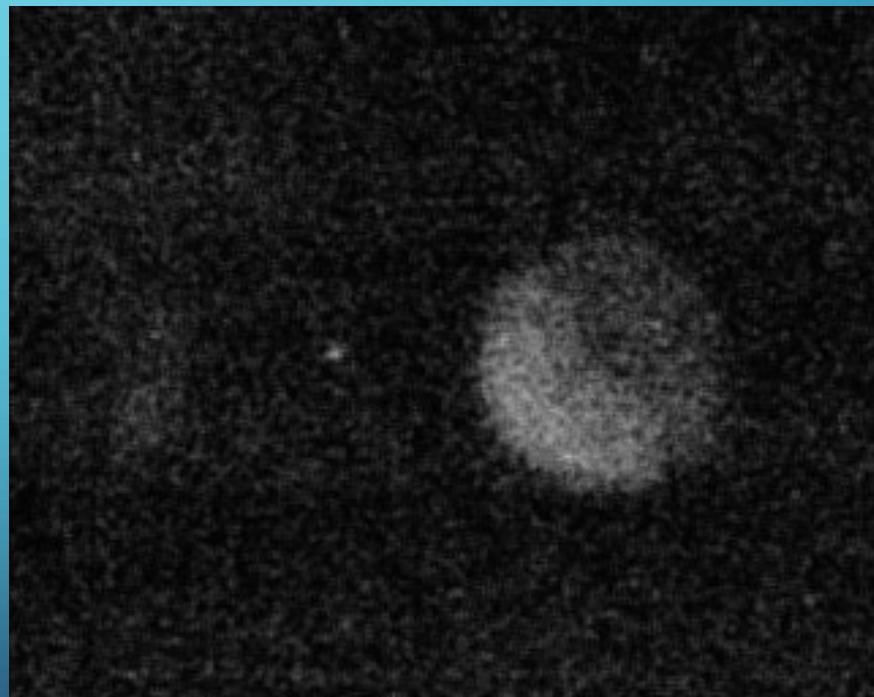


9.4 PROBLEM IMAGE 4

ORIGINAL IMAGE



ALPHA-TRIMMED MEAN FILTER WITH SIZE = 3
AND D = 2



9.5 PROBLEM IMAGE 5

ORIGINAL IMAGE



HARMONIC MEAN FILTER, SIZE = 3
CONTRAHARMONIC MEAN FILTER, SIZE = 3 & Q = -1.25



9.6 PROBLEM IMAGE 6

ORIGINAL IMAGE

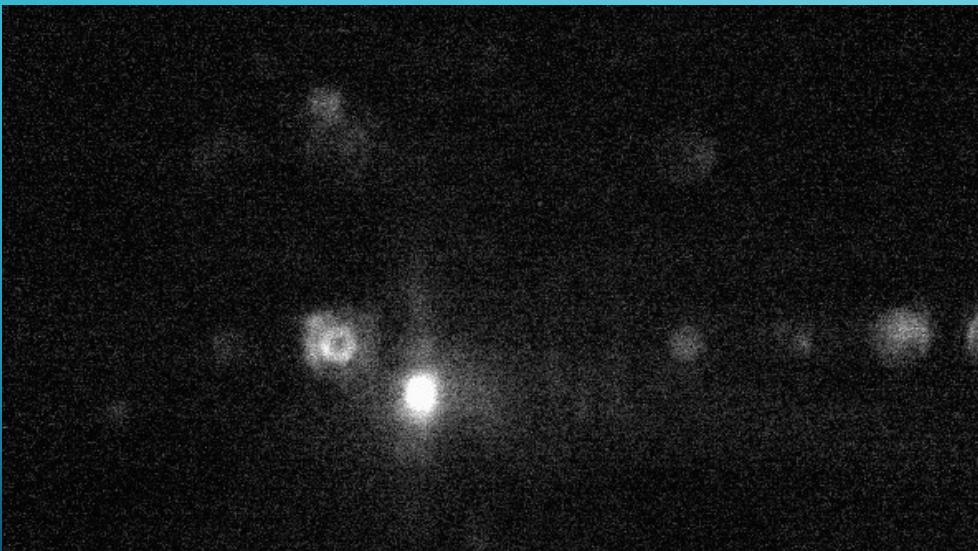


MEDIAN FILTER, SIZE = 3

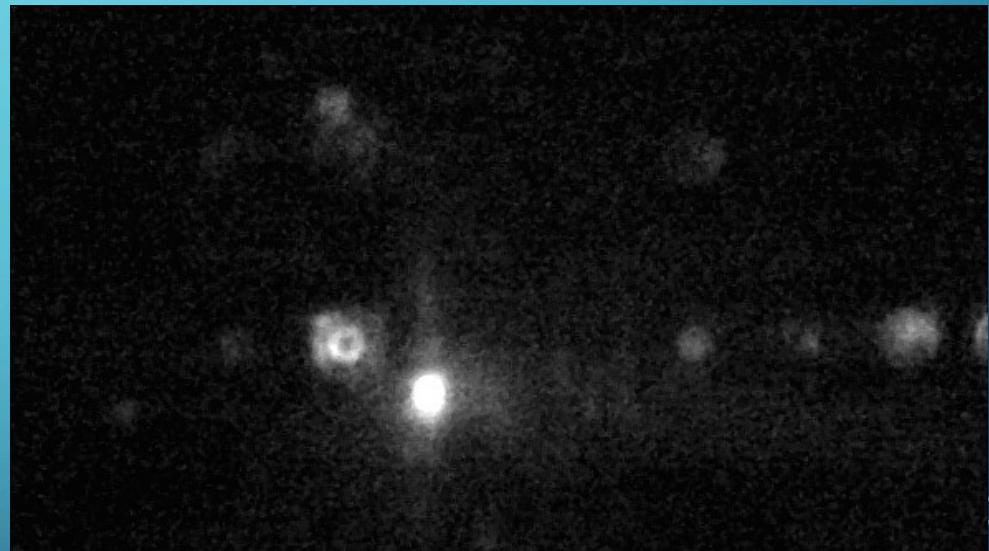


9.7 PROBLEM IMAGE 7

ORIGINAL IMAGE

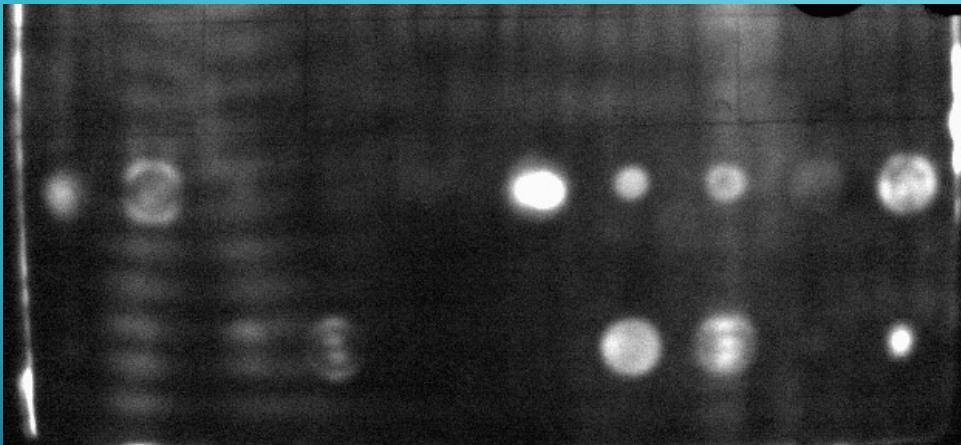


MEDIAN FILTER WITH SIZE 3, POWER TRANSFORM
WITH CONSTANT = 0.75 AND GAMMA = 1.075



9.8 PROBLEM IMAGE 8

ORIGINAL IMAGE

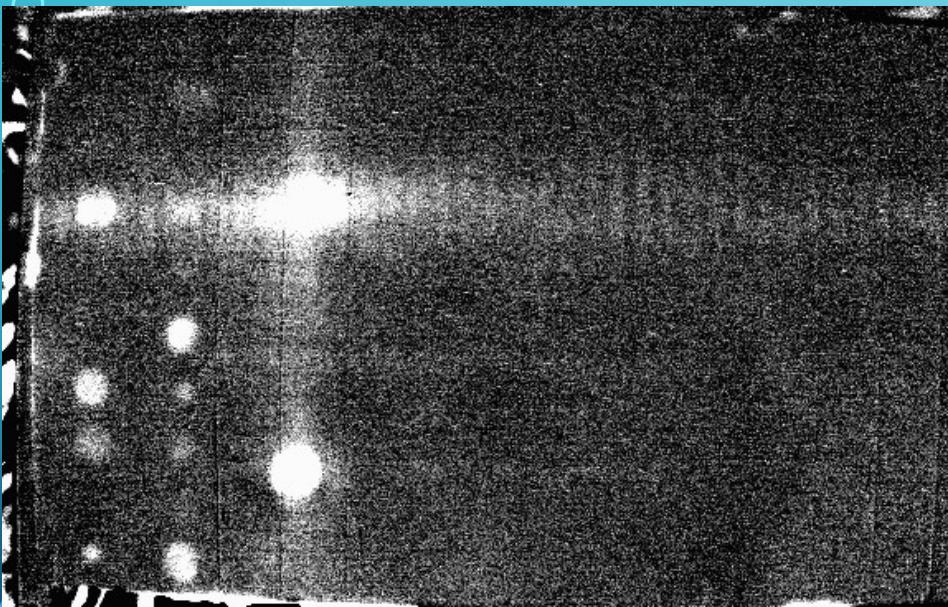


MEDIAN FILTER WITH SIZE 3, POWER TRANSFORM
WITH CONSTANT = 0.75 AND GAMMA = 1.075

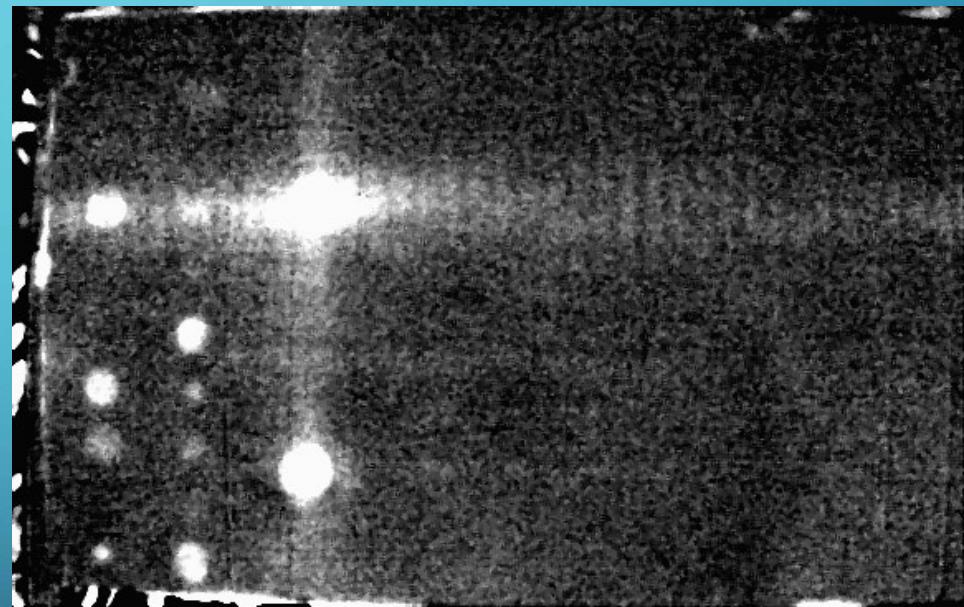


9.8 PROBLEM IMAGE 8

ORIGINAL IMAGE



MEDIAN FILTER WITH SIZE 3, POWER TRANSFORM
WITH CONSTANT = 0.75 AND GAMMA = 1.075





THE END

QUESTIONS ?