



WATERMARK DETECTION

Presentation by Alberto, Felix and Carmen

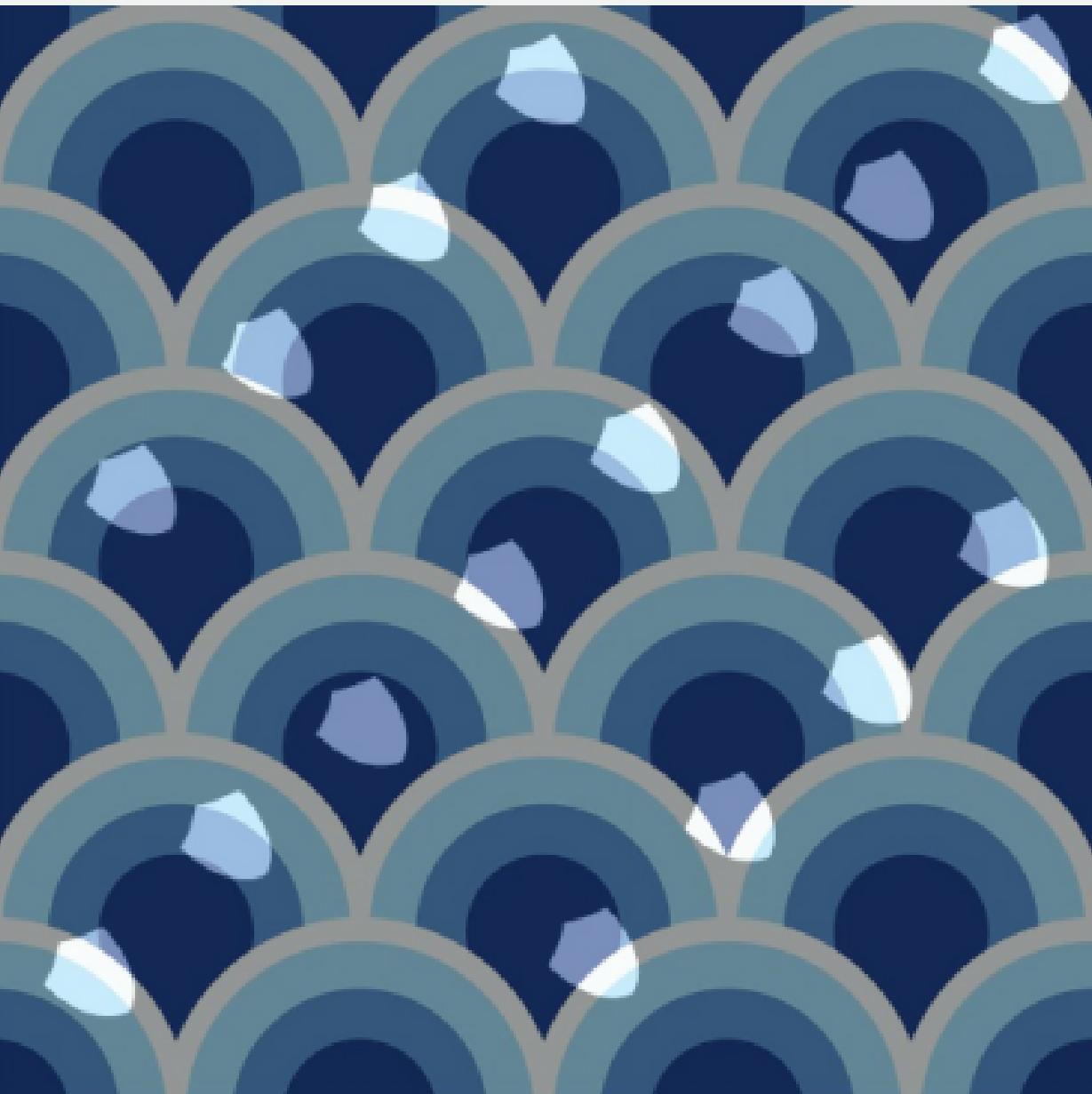


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INTRODUCTION



WHAT IS A WATERMARK?

$$X(p) = \alpha(p)W(p) + (1 - \alpha(p))Y(p)$$



+



0.6

0.4

IMPLEMENTATION

TV-L1

Image
preprocessing

CANNY

Extract image
edges

OTSU

Edges
classification

TV-L1

$$TV_{\ell^1}(X) = \sum_{i,j \in N} \sum_k \|x_{i,k} - x_{j,k}\|_1$$

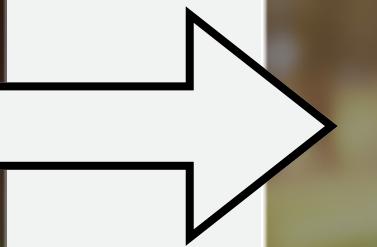


Reduce details



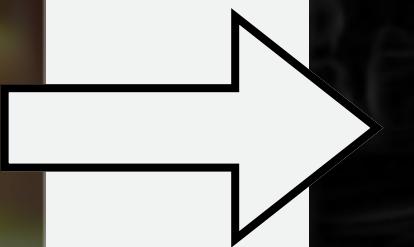
CANNY

Noise reduction



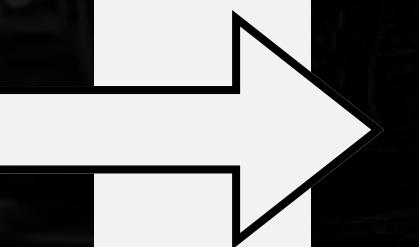
CANNY

Intensity gradient



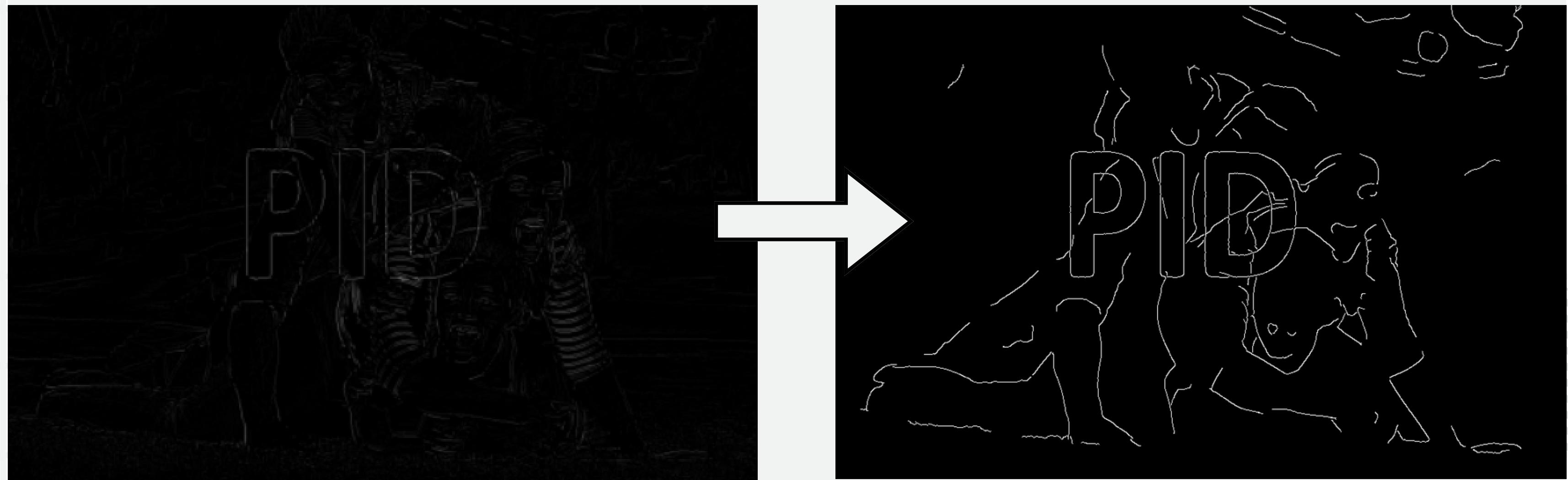
CANNY

Non-maximum suppression



CANNY

Double thresholding and hysteresis

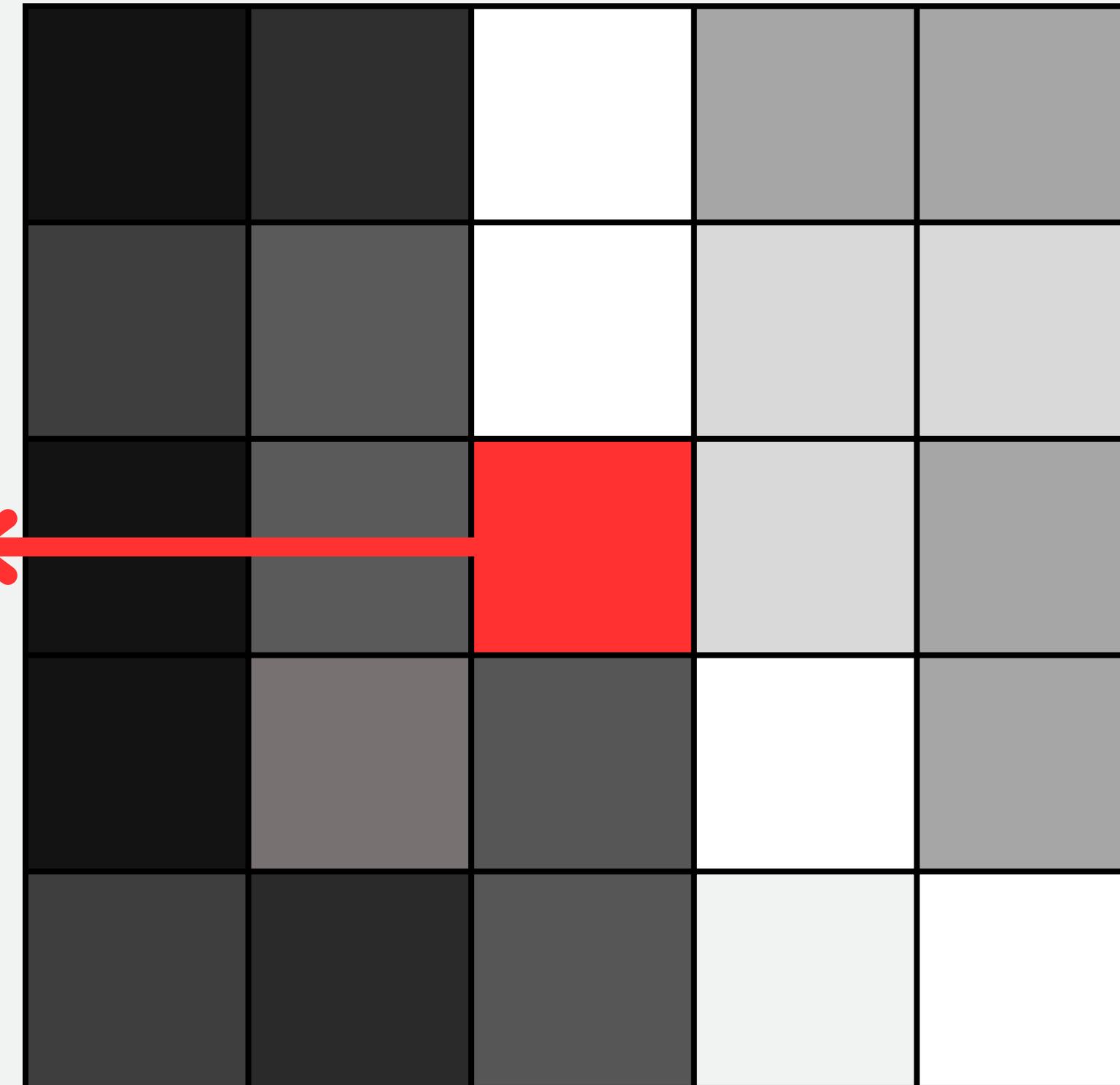


OTSU



OTSU

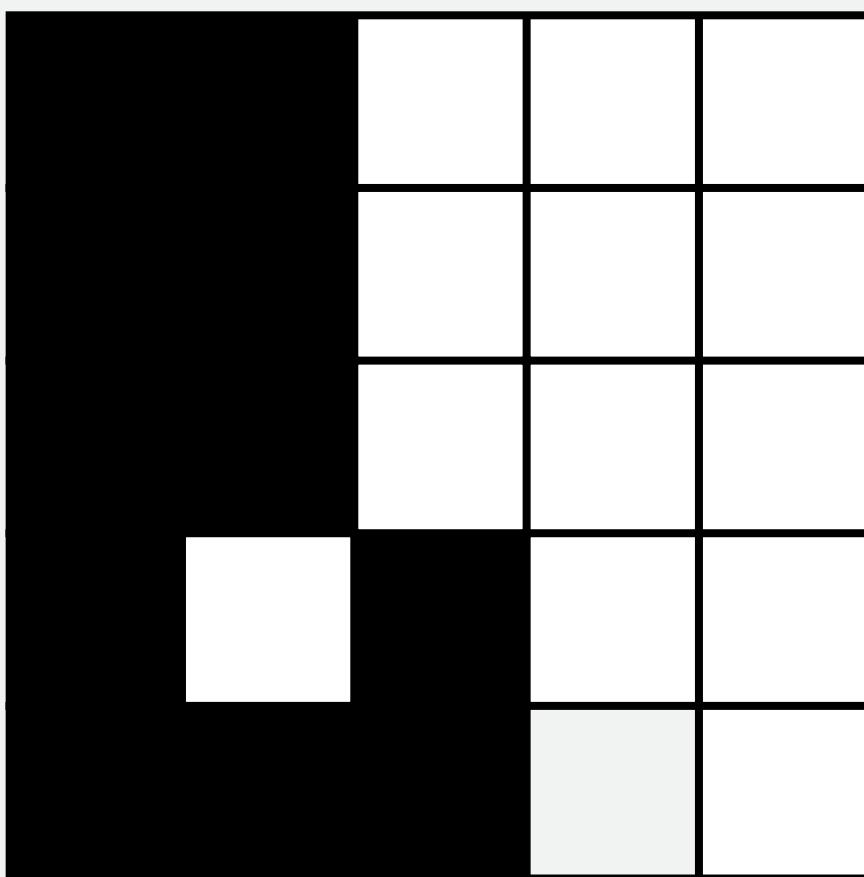
Pixel that
belongs to an
edge



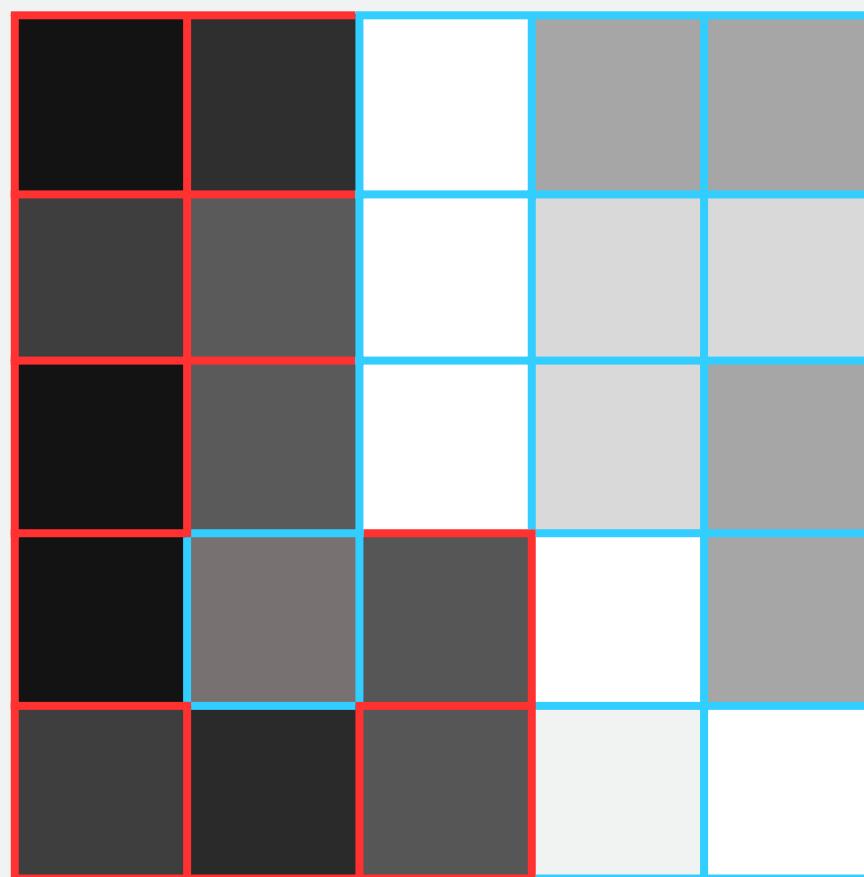
kxk block
Apply Otsu to
the block

OTSU

Otsu result



Original block
(grouped by
threshold)

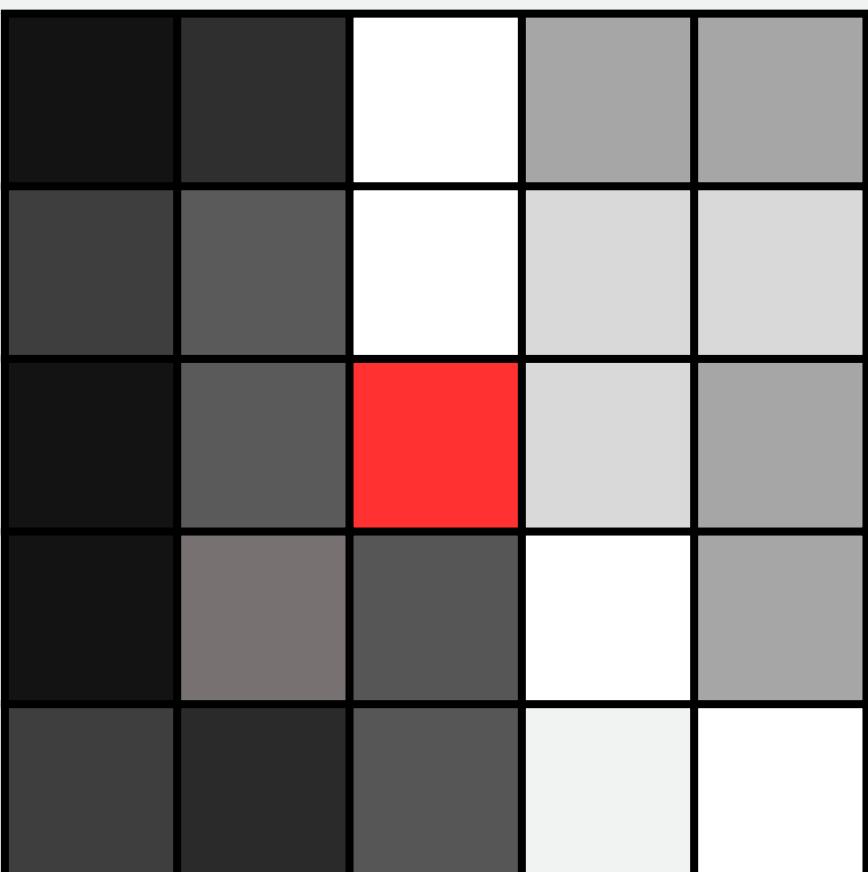


$$\mu_b^q = \frac{1}{N} \sum_{i=1}^N P_{\text{above},i}$$

$$\mu_o^q = \frac{1}{N} \sum_{i=1}^N P_{\text{below},i}$$

$$\rho_b = \mu_b^q - \mu_o^q$$

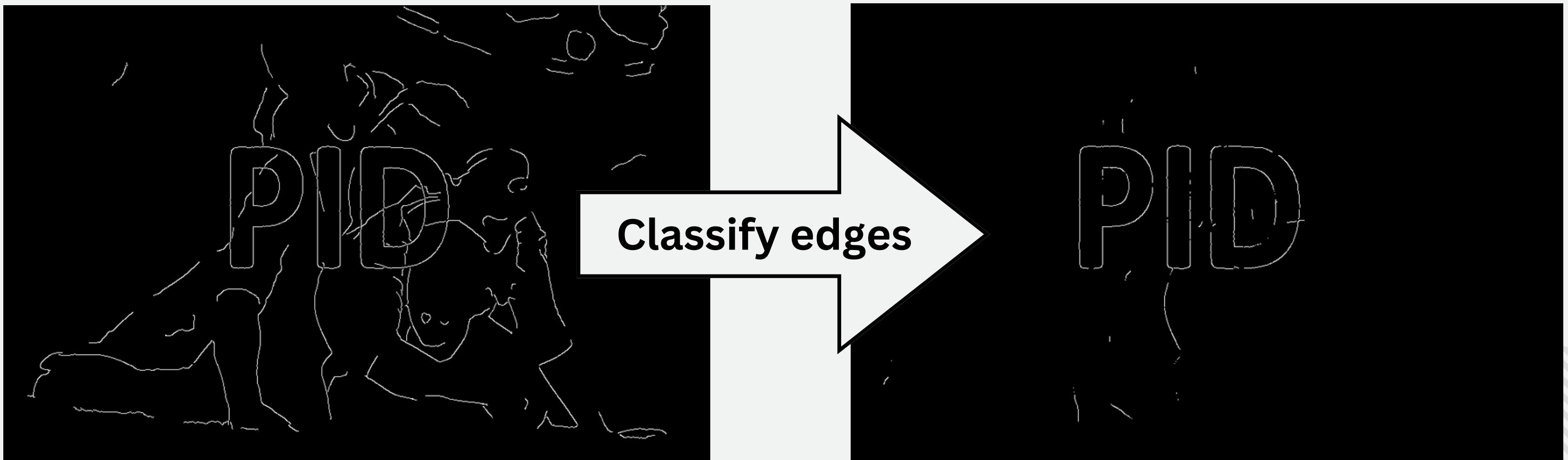
OTSU



if $\begin{cases} d - r \leq \rho_b \leq d + r & \text{Watermark} \\ \text{otherwise} & \text{NO Watermark} \end{cases}$



OTSU

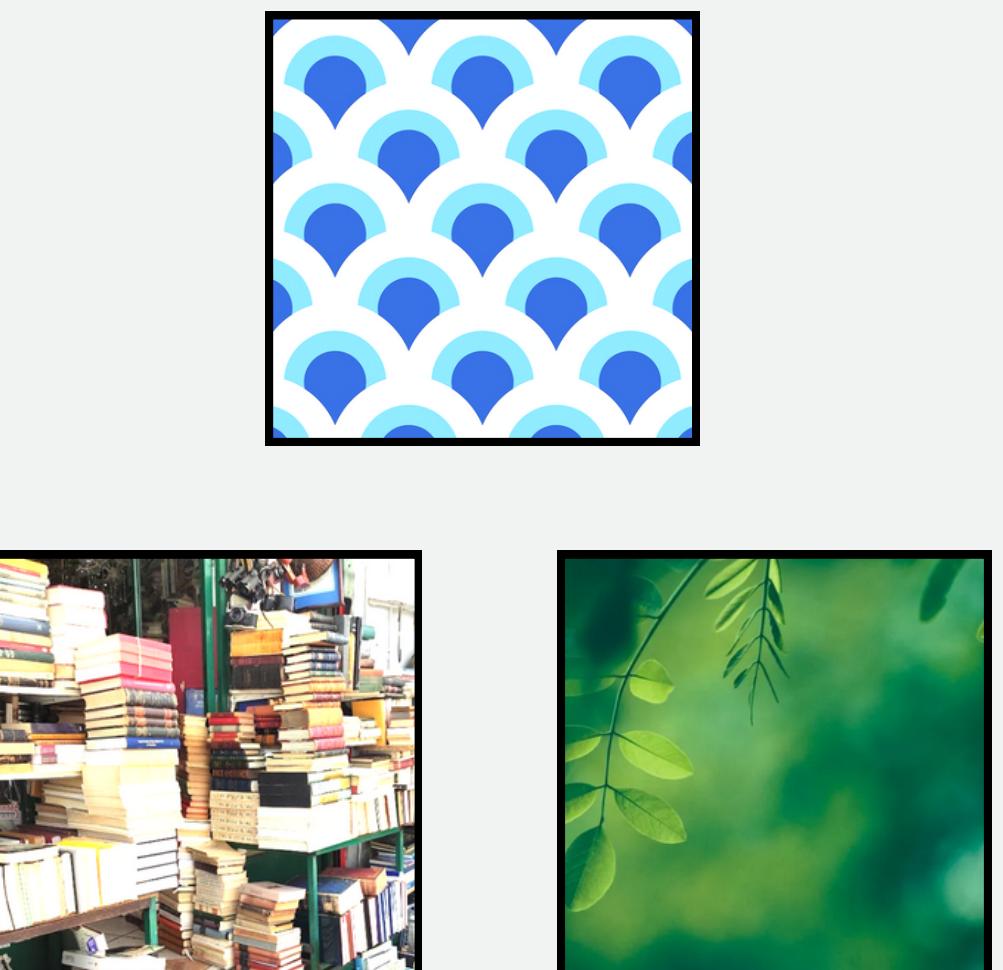


EXPERIMENTATION

Parameters

K	D	R
5	26	10
7	36	15
...
21	96	30

Host images

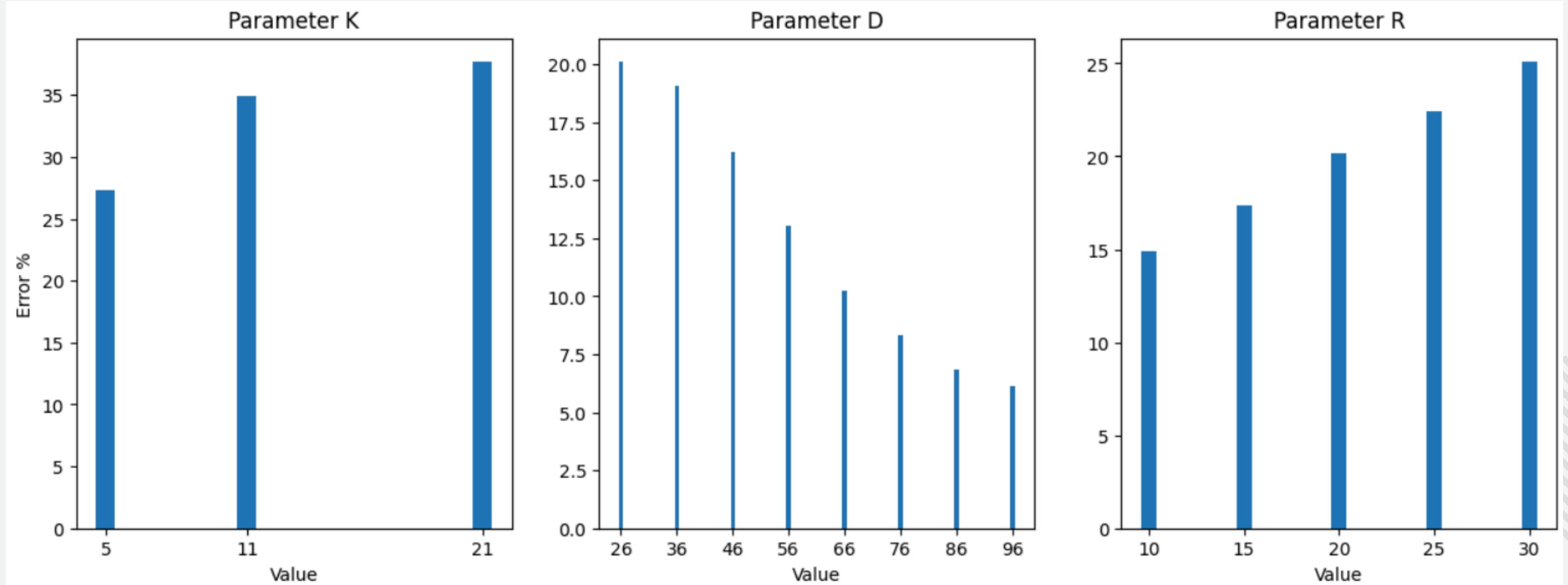


Watermarks



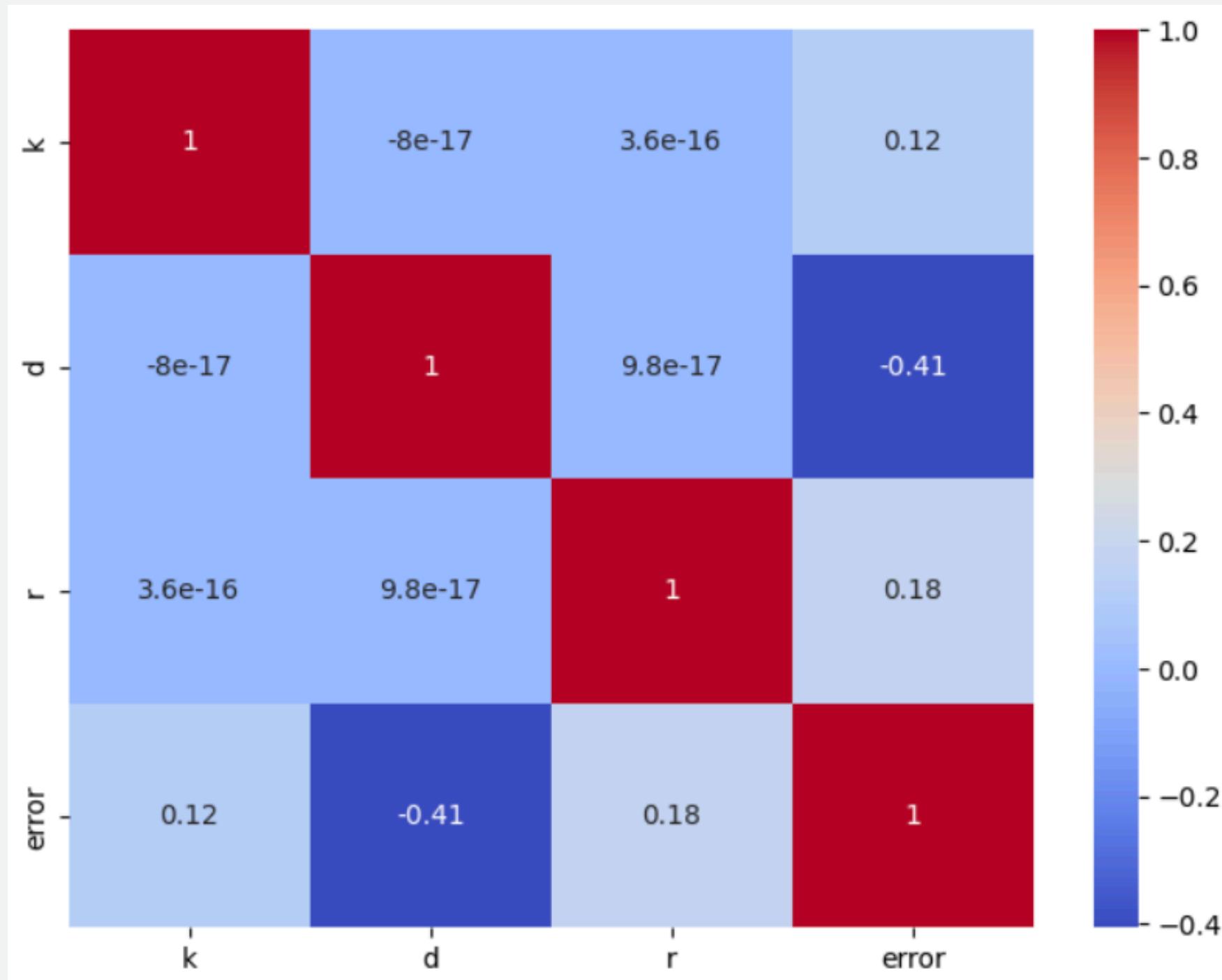
EXPERIMENTATION

Pattern Images



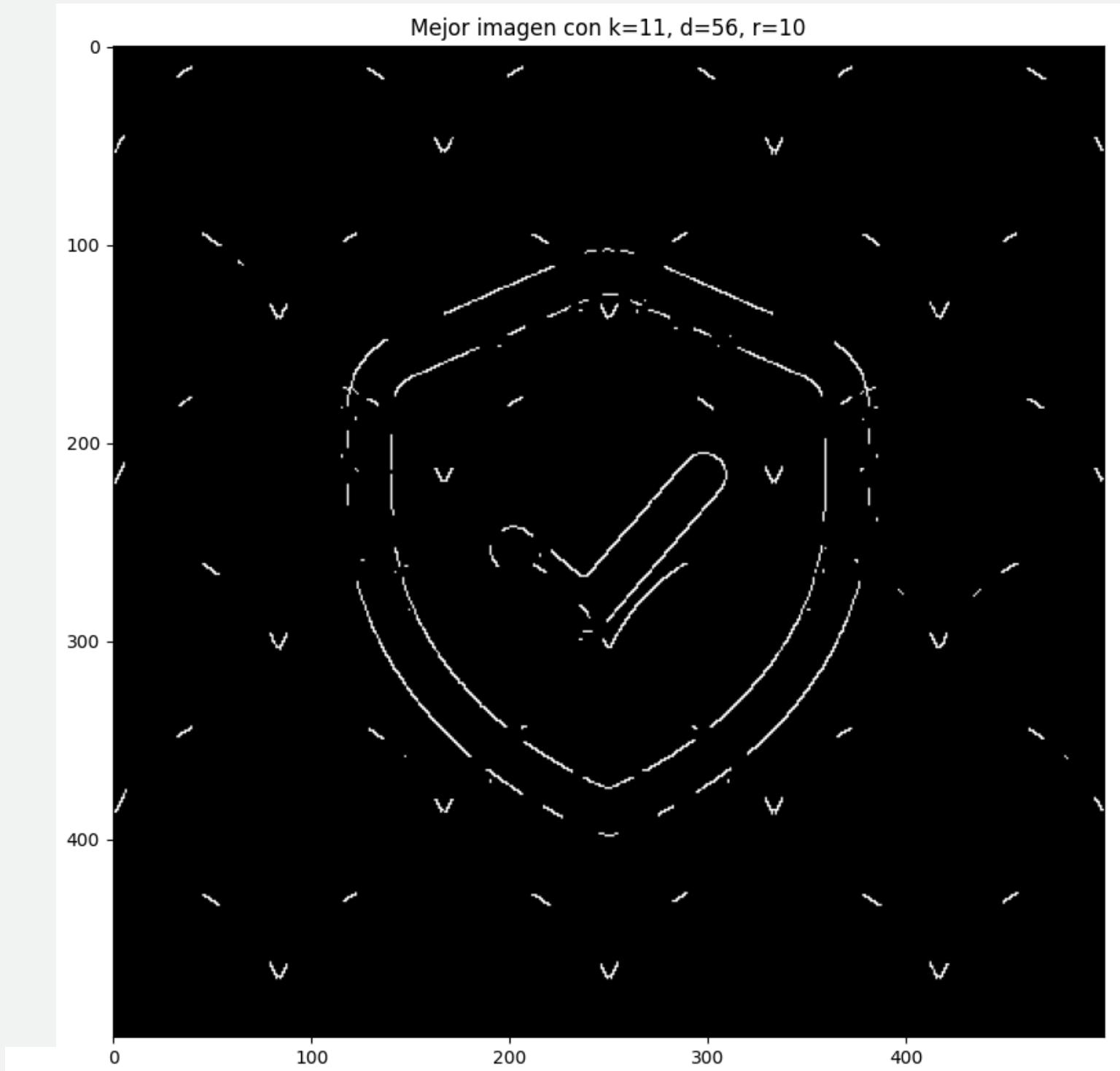
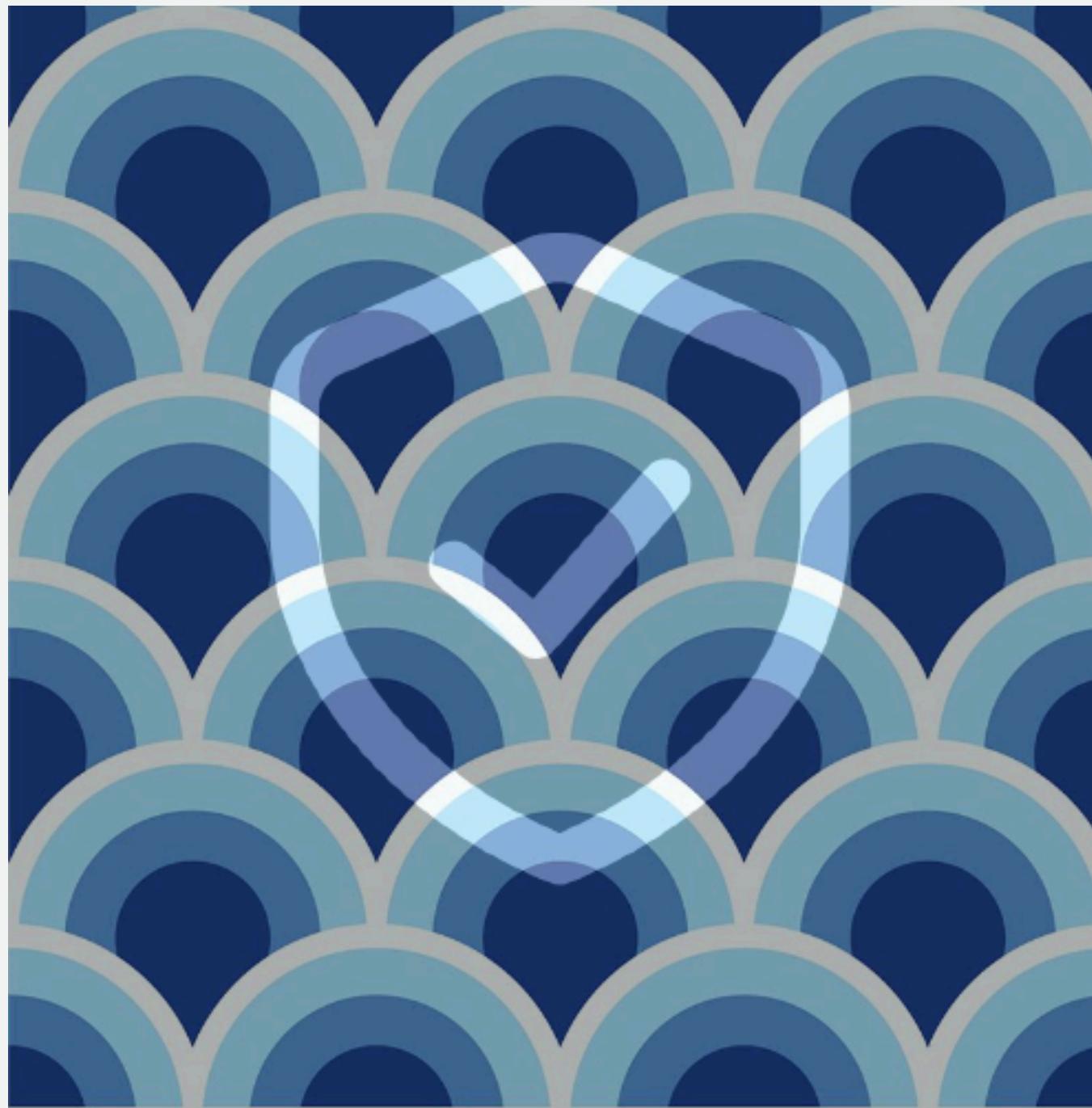
EXPERIMENTATION

Pattern Images



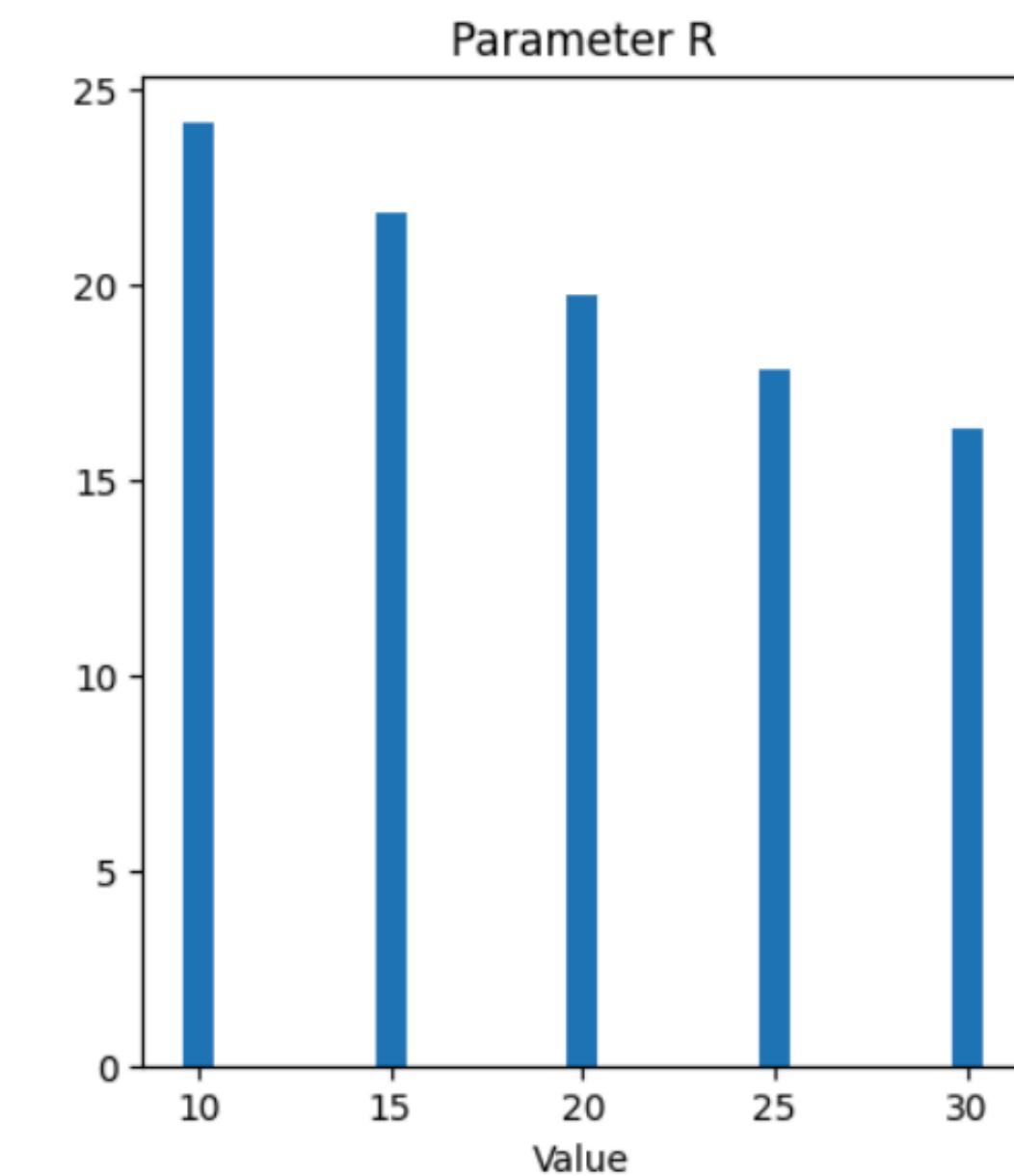
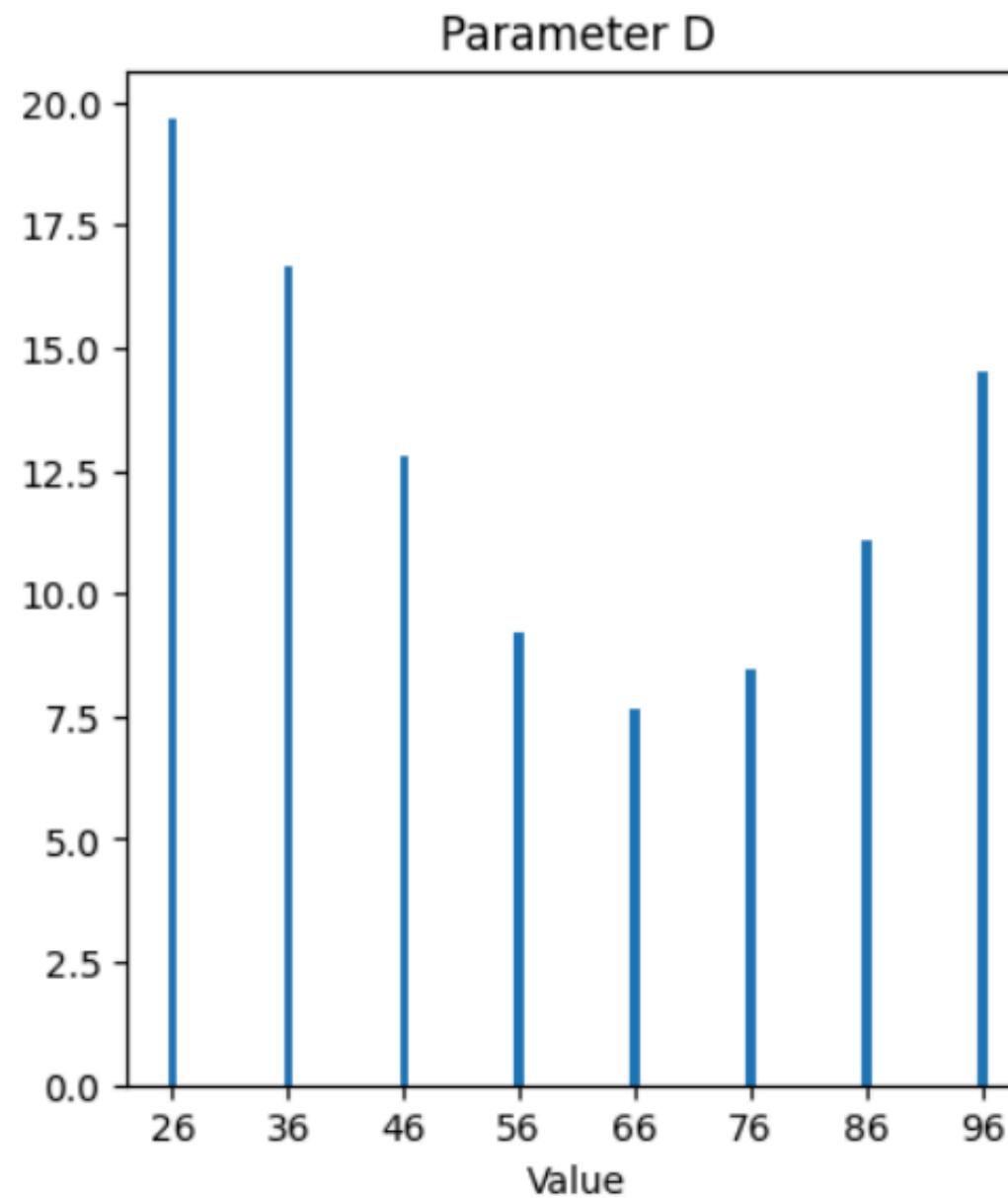
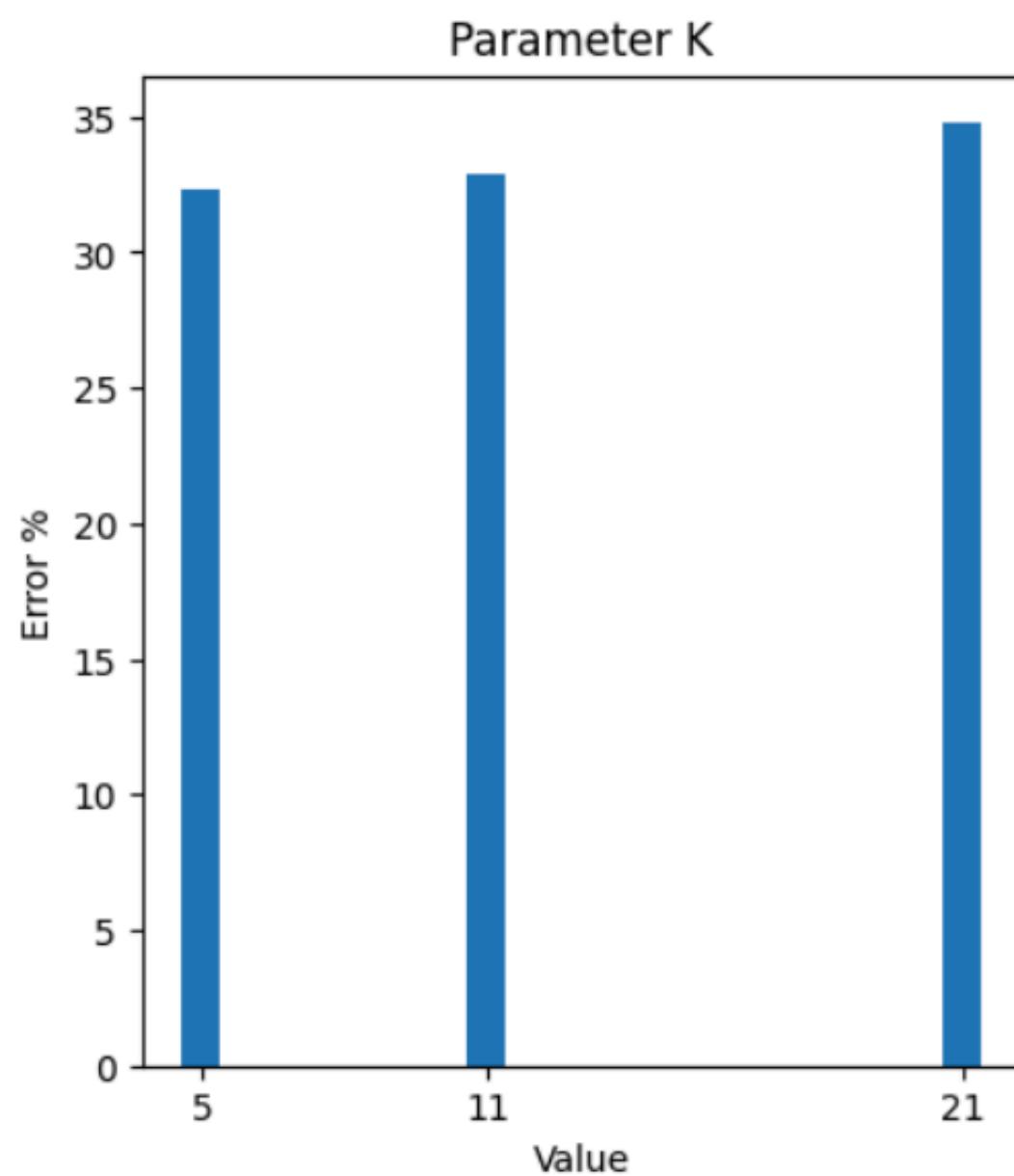
EXPERIMENTATION

Pattern Images



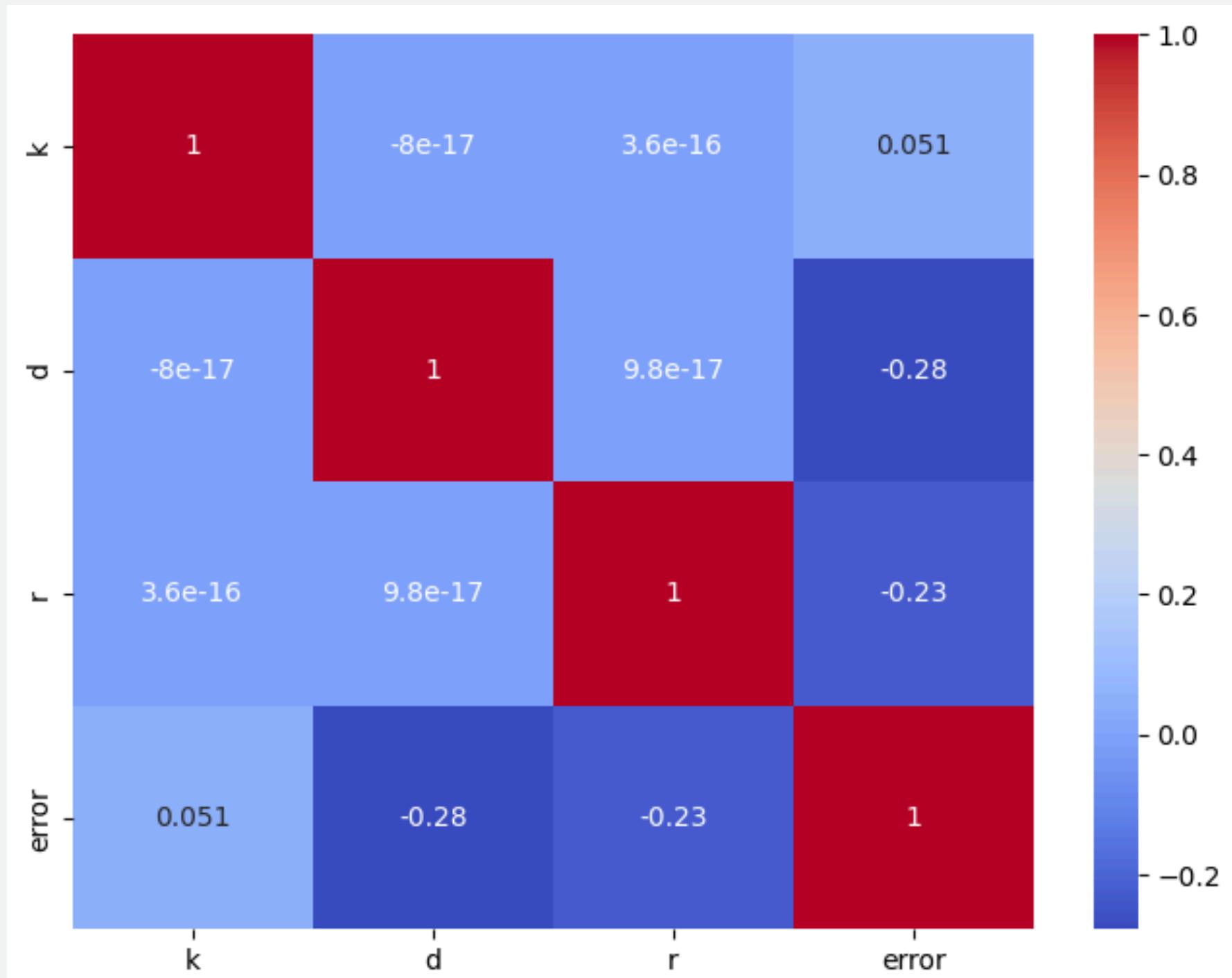
EXPERIMENTATION

Low Details Images



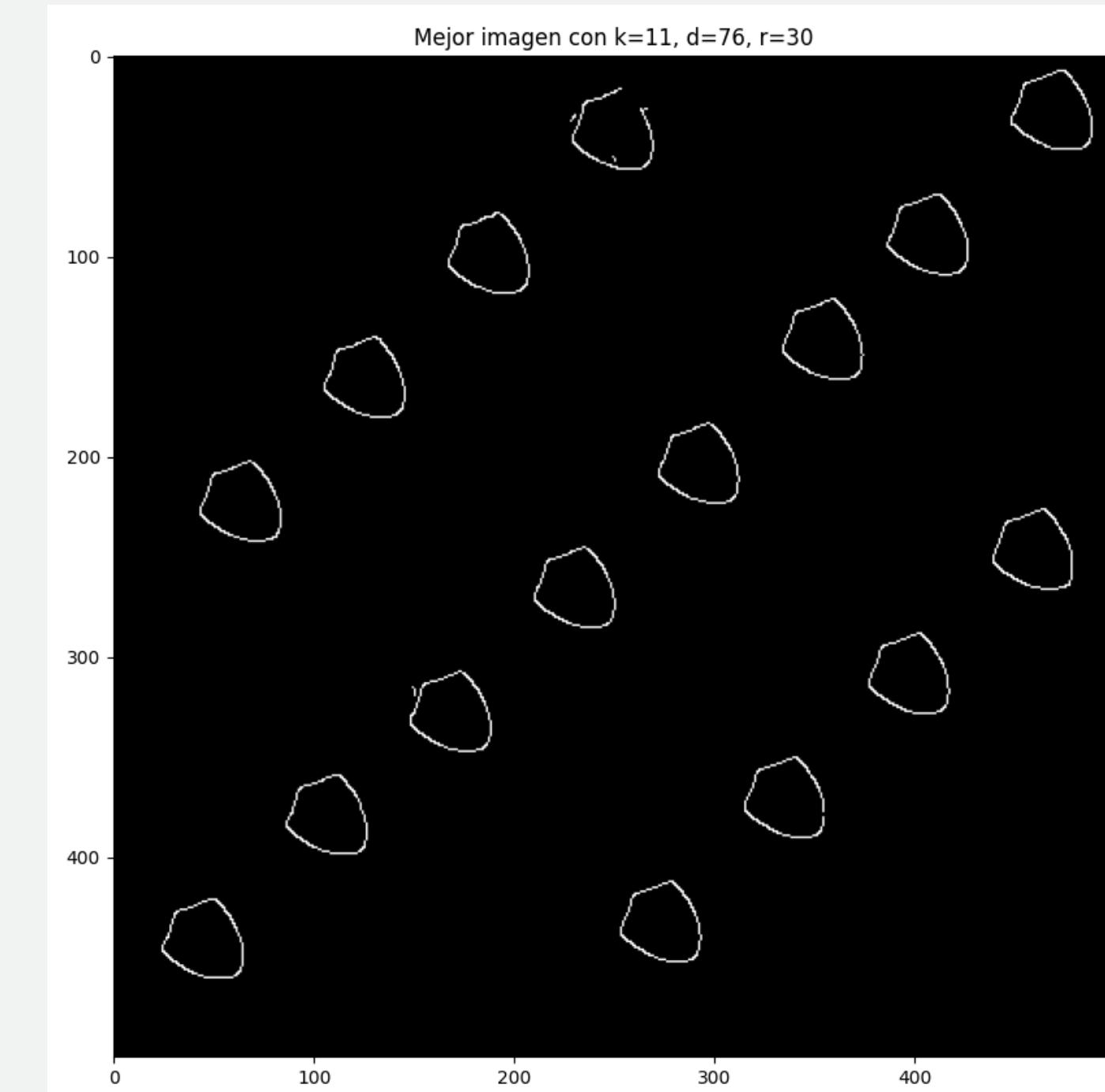
EXPERIMENTATION

Low Details Images



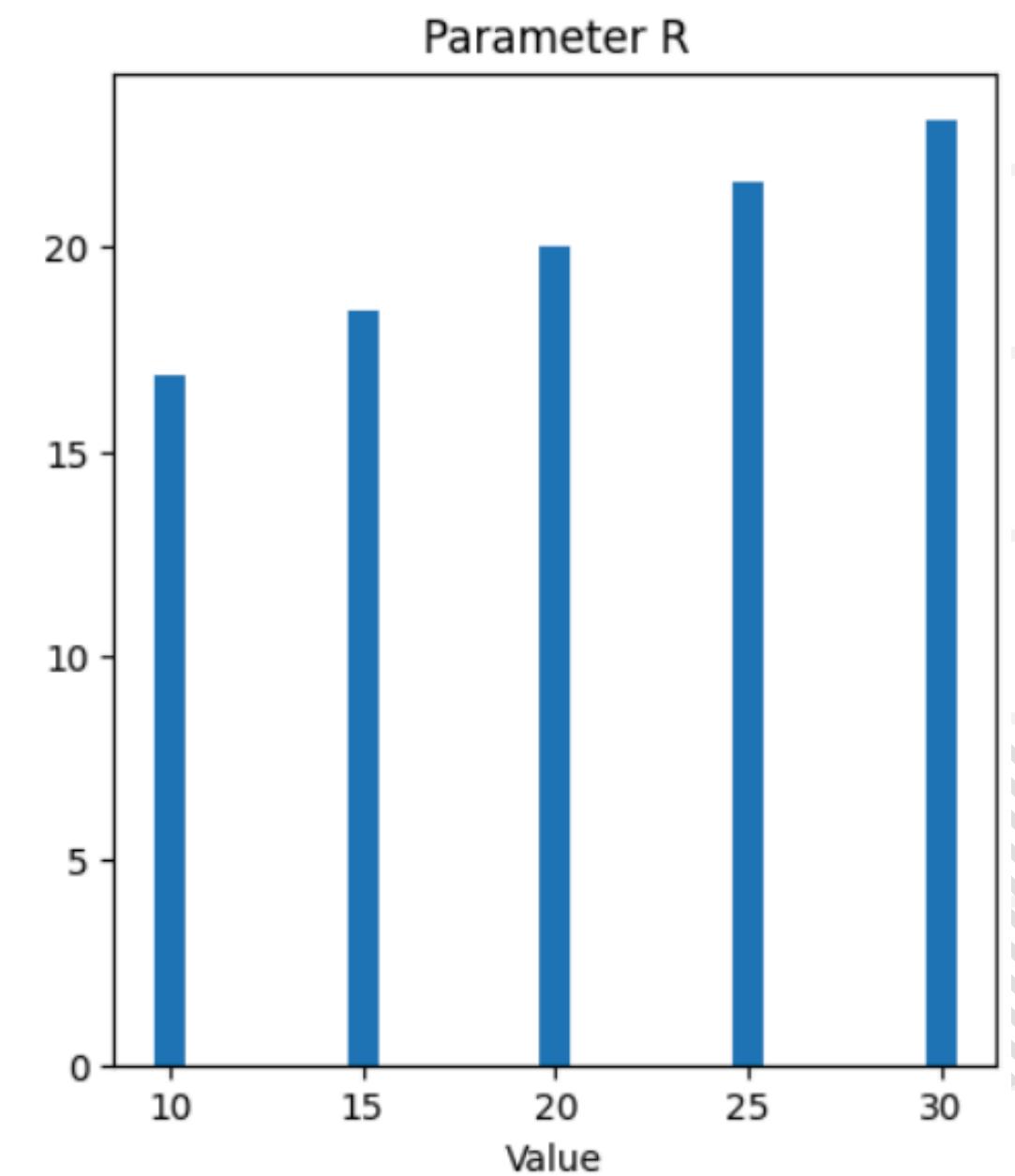
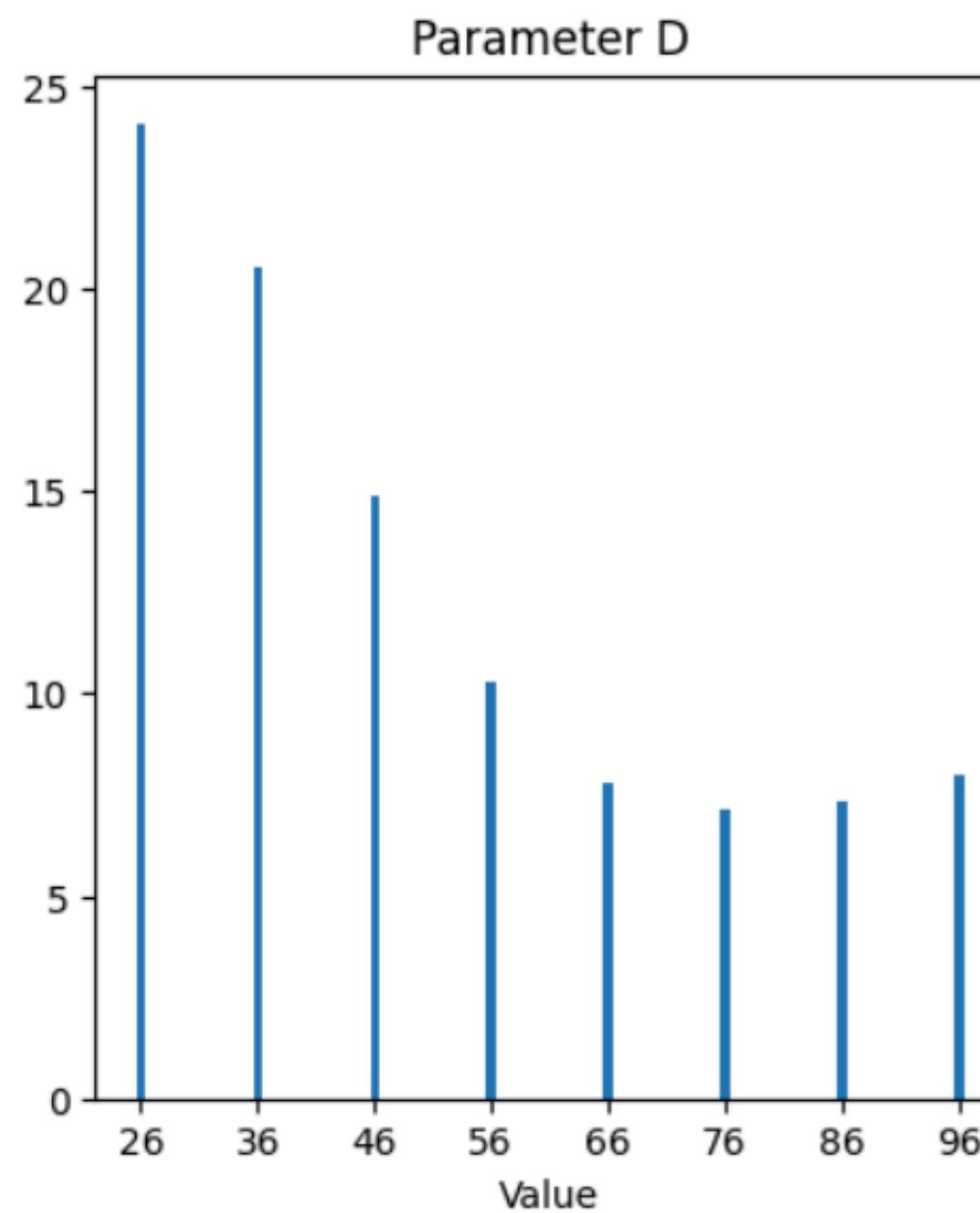
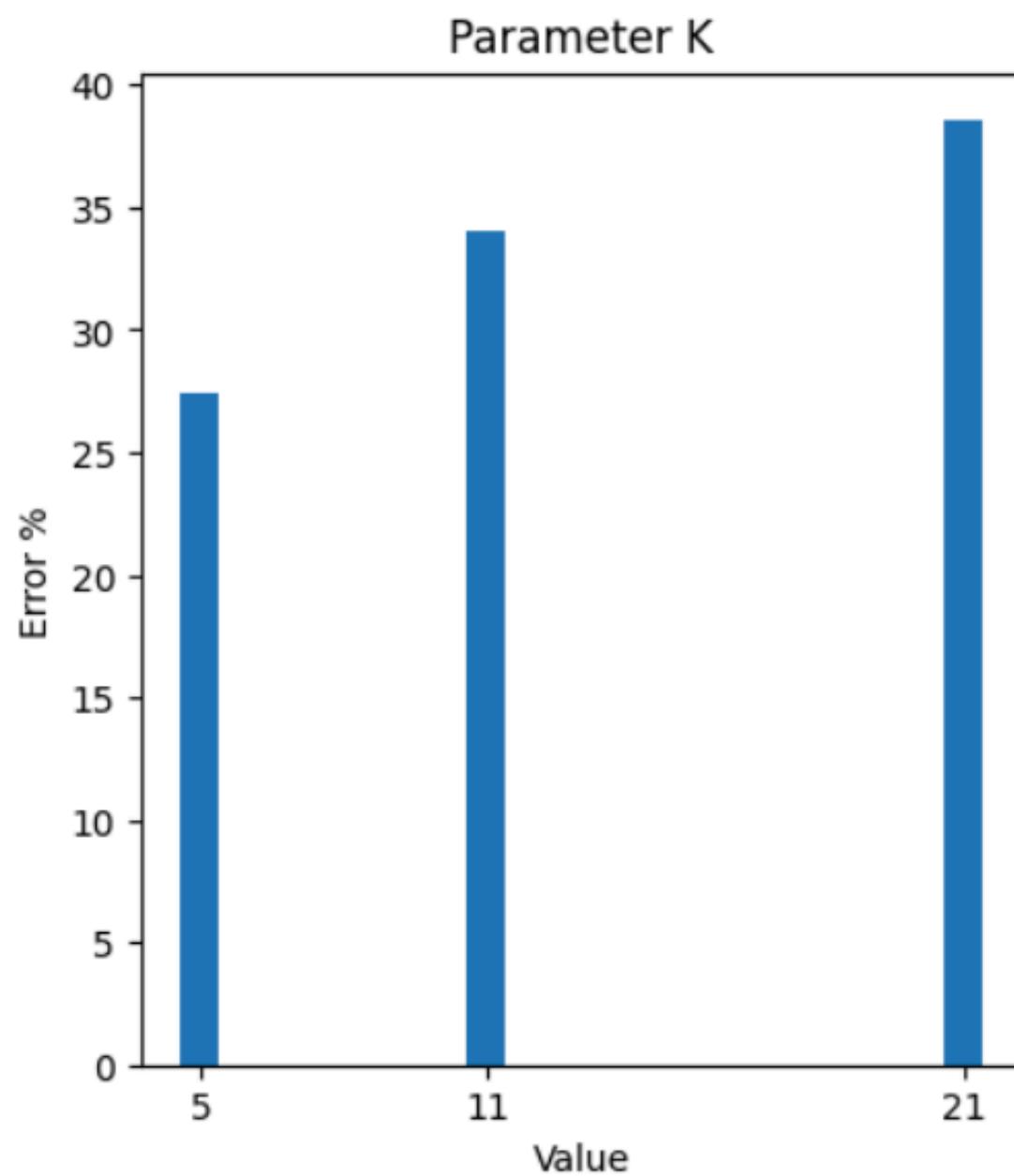
EXPERIMENTATION

Low Details Images



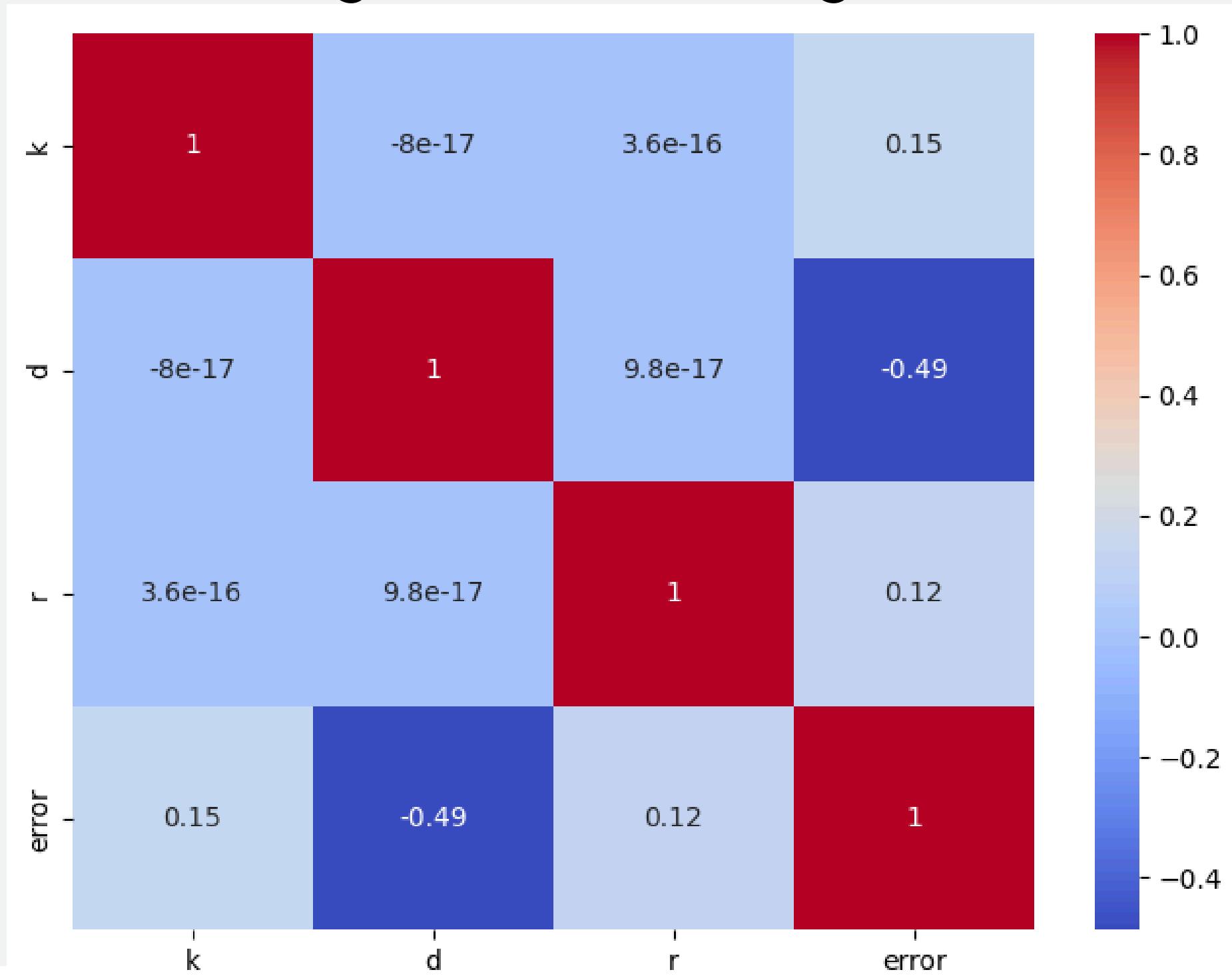
EXPERIMENTATION

High Details Images



EXPERIMENTATION

High Details Images



EXPERIMENTATION

High Details Images



FUTURE WORK



**Improve performance
by error guide
heuristic algorithms**



**Implement watermark
removal and
inpainting algorithm**

CONCLUSION

- ❑ DEVELOPED A WATER MARK DETECTION SYSTEM
- ❑ STUDIED THE RELEVANCE OF THE PARAMETERS USED
- ❑ AUTOMATIZED THE TESTING OF PARAMETERS
- ❑ RELATED IMAGE TYPES TO PARAMETERS TO USE



BIBLIOGRAPHY

An Automatic Visible Watermark Detection Method using Total Variation

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[H. Santoyo-Garcia, E. Fragoso-Navarro, R. Reyes-Reyes, G. Sanchez-Perez, M. Nakano-Miyatake and H. Perez-Meana, "An automatic visible watermark detection method using total variation," 2017 5th International Workshop on Biometrics and Forensics \(IWBF\), Coventry, UK, 2017, pp. 1-5, doi: 10.1109/IWBF.2017.7935109.](#)

THANK YOU

