

Image Splicing Detection and Localisation using Digital Forensics

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Overview

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Splicing

Authentic



Spliced



- Image Splicing
 - forger technique
 - digital image editing tools
 - separate image sources
- Copy-Move
- Localisation



Need for Detecting Splicing and Localising Splices

- News Reports
- Photography Contest
- Key proof in academic papers
- Forensic Investigation
- Social-Media Tampering



Problem Statement

“Given a spliced image, localize the spliced region”

Input



Expected



Approach

Supapixel Segmentation

Simple Linear Iterative Clustering (SLIC)

Noise Estimation (σ) of each Supapixel

Principal Component Analysis (PCA)
Robust wavelet-based approach

Binary Clustering of Noise Estimates

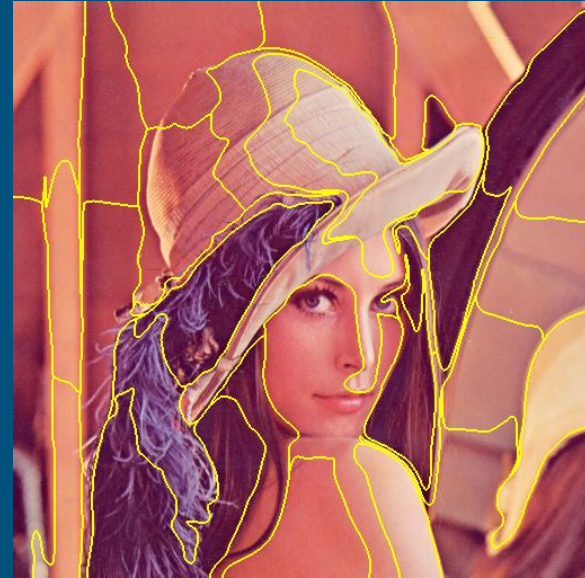
k-means++ clustering

Splicing Localisation

Cluster superpixels using noise clusters



Superpixel Segmentation

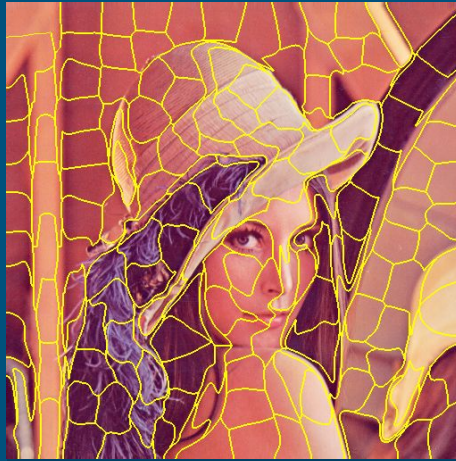


parameter k — approximate number of superpixels

Superpixel Segmentation



$k = 100$ (actual 85)



$k = 200$ (actual 166)



$k = 300$ (actual 255)

Noise Estimation (σ)



$\sigma = 0.6639337$

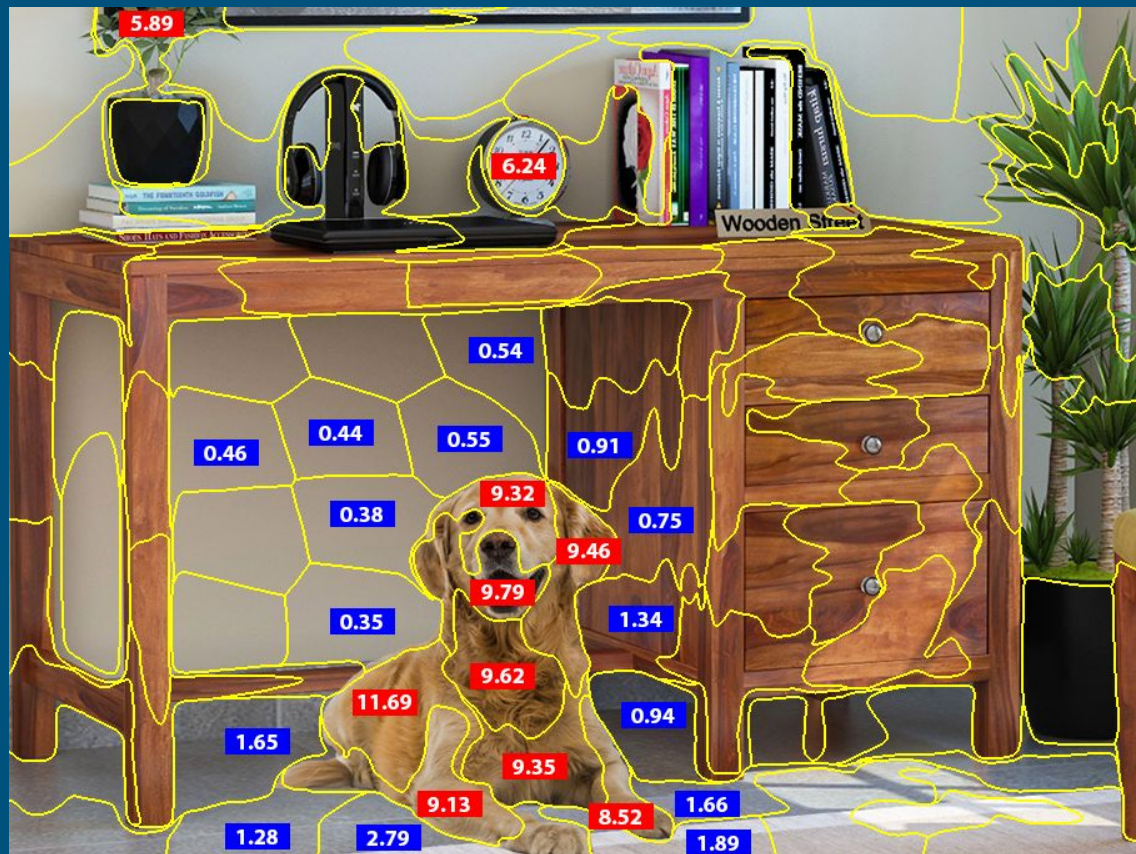


$\sigma = 2.7077480$

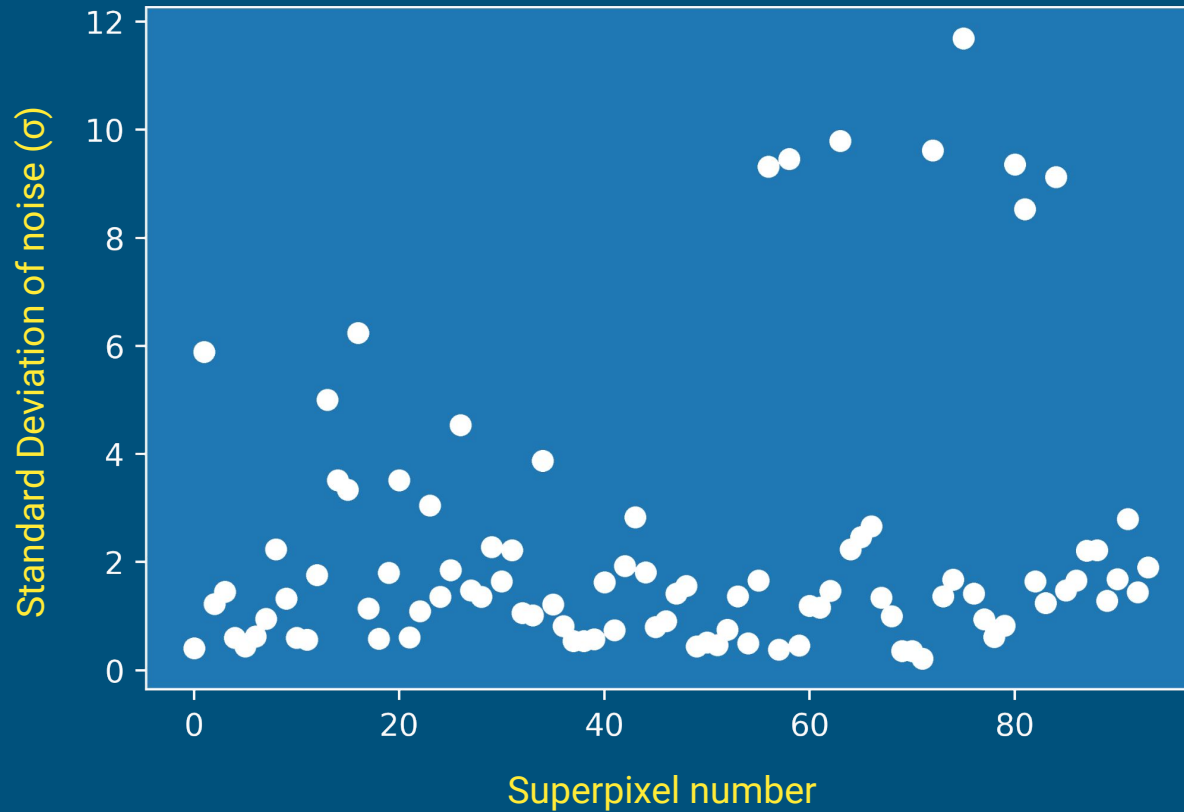


$\sigma = 20.2096597$

Noise Estimation (σ)



Noise Clusters



Live Demo



Results



	Actual Positive	Actual Negative
Predicted Positive	48047	11324
Predicted Negative	2731	553978
Precision	0.809267150629095	
Recall	0.946216865571704	
F_1 -score	0.872400112574785	



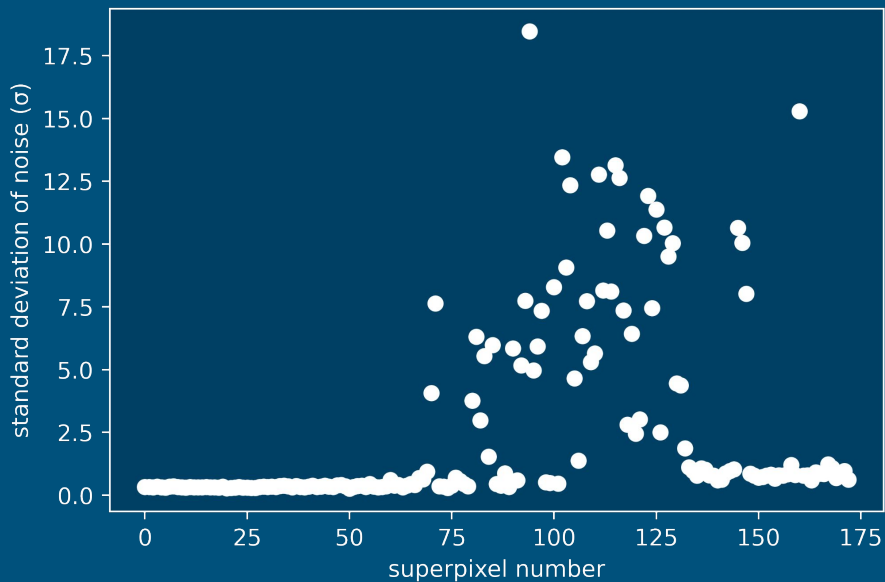
Experimental Results



Experimental Results



Experimental Results



	Actual Positive	Actual Negative
Predicted Positive	13532	32449
Predicted Negative	2406	213757
Precision	0.294295469867989	
Recall	0.849040030116702	
F ₁ -score	0.437087162260372	

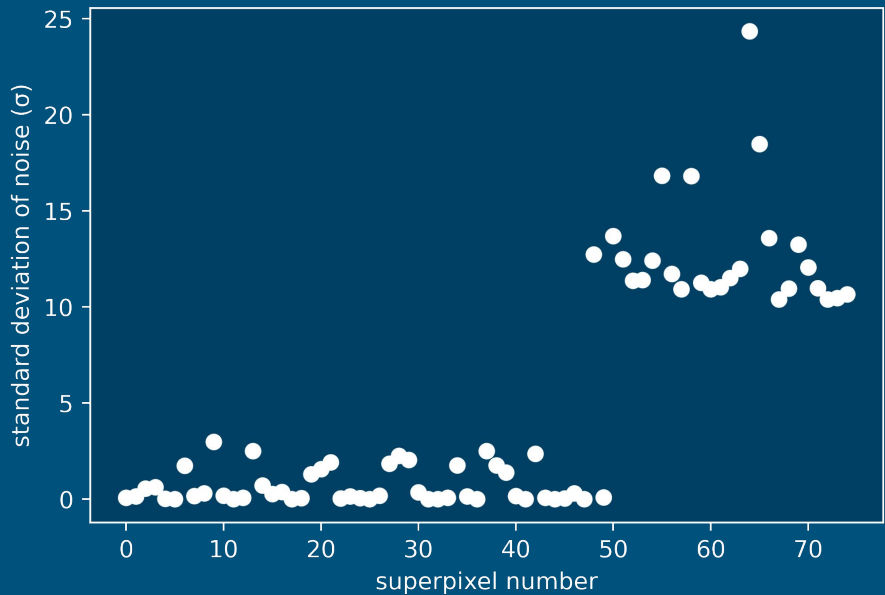
Experimental Results



Experimental Results



Experimental Results



	Actual Positive	Actual Negative
Predicted Positive	80170	0
Predicted Negative	4135	151362
Precision	1.0	
Recall	0.950951900836249	
F ₁ -score	0.974859401124791	

100%

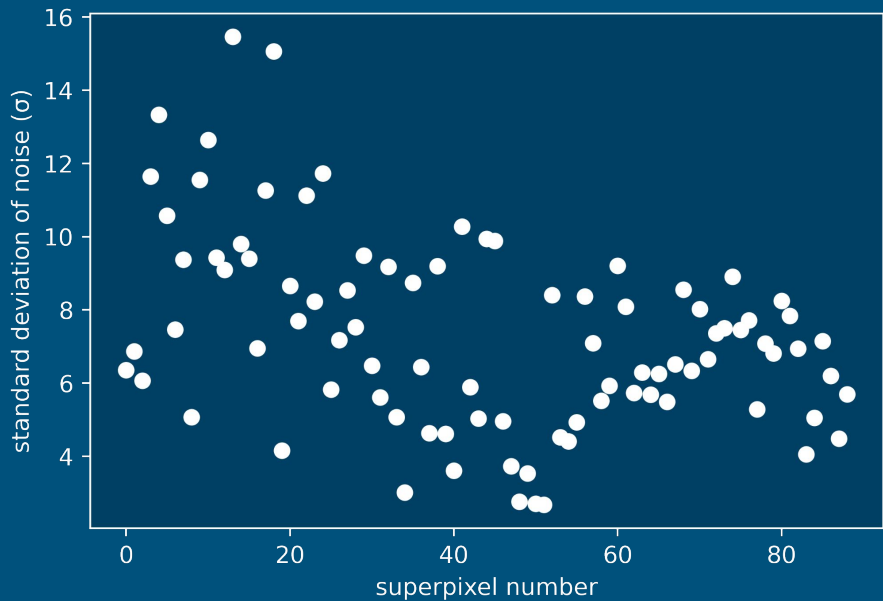
Experimental Results



Experimental Results



Experimental Results



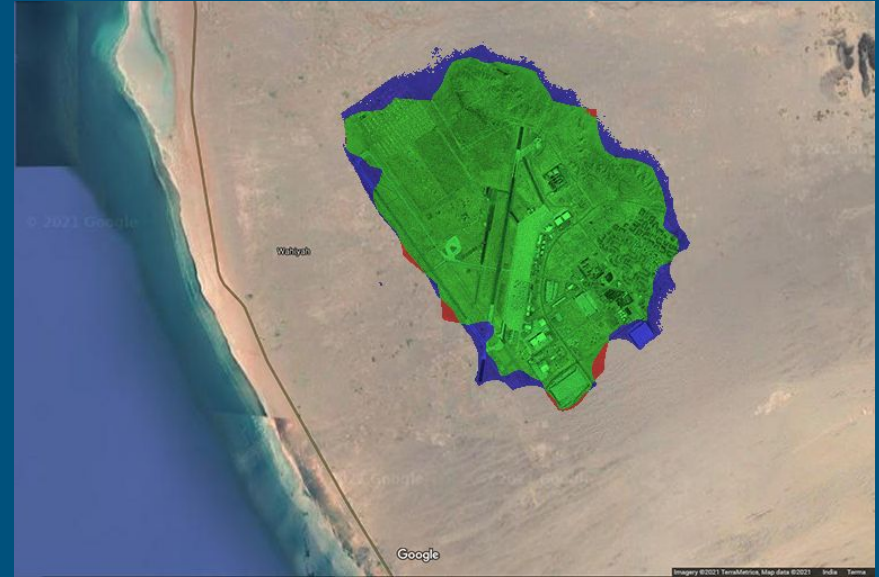
	Actual Positive	Actual Negative
Predicted Positive	26008	63609
Predicted Negative	2102	170425
Precision	0.290212794447482	
Recall	0.925222340803984	
F ₁ -score	0.441835772592523	



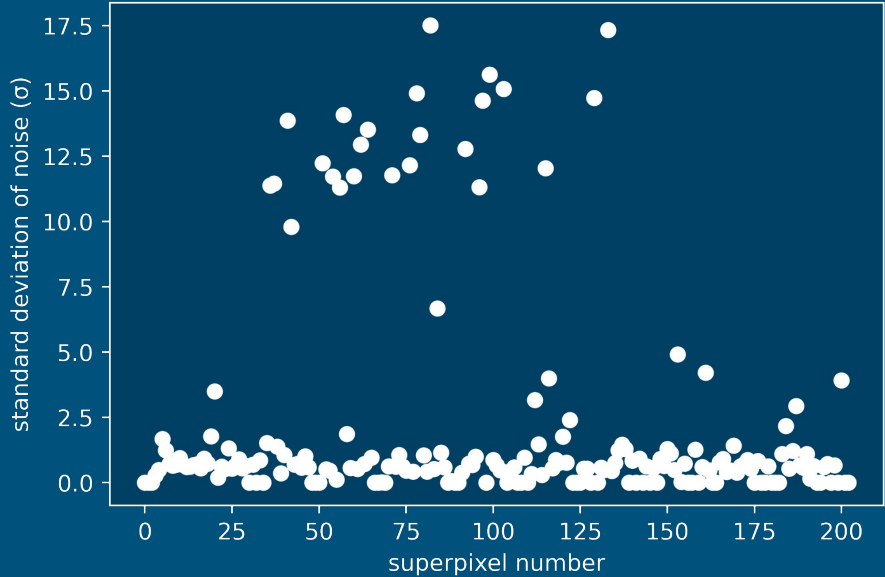
Experimental Results



Experimental Results



Experimental Results



	Actual Positive	Actual Negative
Predicted Positive	52434	675
Predicted Negative	7592	405731
Precision	0.987290289781393	
Recall	0.873521474027921	
F ₁ -score	0.926928006364078	

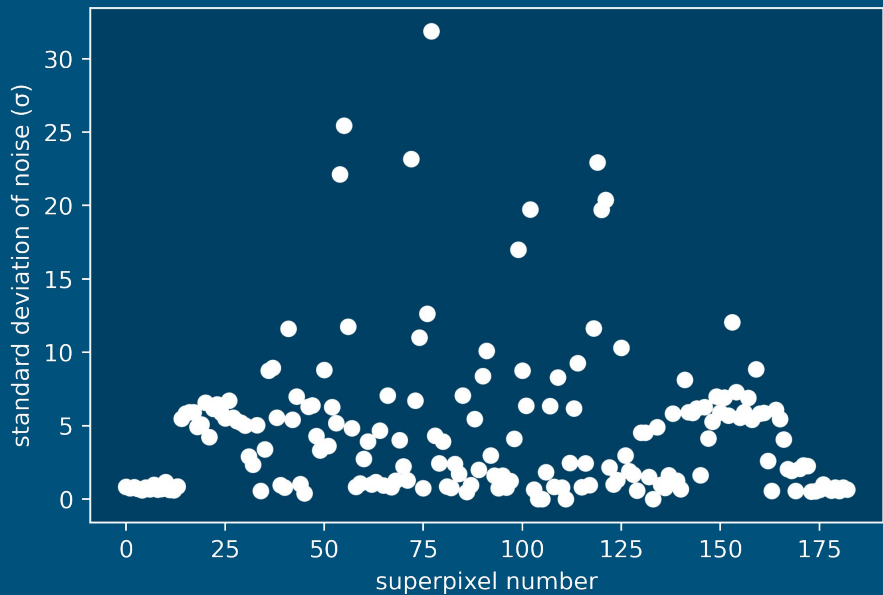
Experimental Results



Experimental Results



Experimental Results

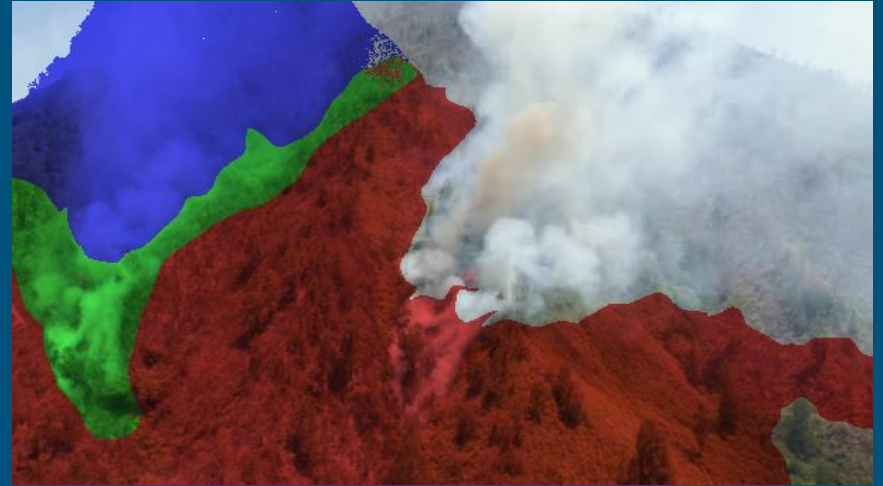


	Actual Positive	Actual Negative
Predicted Positive	4939	3134
Predicted Negative	4727	236800
Precision	0.611792394401090	
Recall	0.510966273536106	
F ₁ -score	0.556852133716669	

Experimental Results



Experimental Results



Conclusion

Sources	Two or more photographic sources Copy-move not handled
Noise quality	Small σ in each cluster Distinguishably different σ between clusters
k value	Supapixel sizes — good approximation of artifacts
Precision	Smaller superpixel sizes
Localisation	Regions are clustered based on noise Marking cluster as spliced region is heuristic

References

- 1) Siqian Li, Weimin Wei, Xiuru Hua, Xueling Chu. “Image Splicing Localization Using Superpixel Segmentation and Noise Level Estimation.” In 2019 12th International Congress on Image and Signal Processing,

 - 2) R. Achanta, A. Shaji, K. Smith, A. Lucchi, P. Fua, and S. Ssstrunk. “SLIC Superpixels Compared to State-of-the-Art Superpixel Methods.” In IEEE Transactions on Pattern Analysis and Machine Intelligence, Nov 2012.

 - 3) D. F. Donoho, I. M. Johnstone. “Ideal spatial adaptation by wavelet shrinkage.” In Biometrika, Volume 81, Issue 3, September 1994.
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