

# TAMPERING DETECTION AND LOCALIZATION IN IMAGES FROM SOCIAL NETWORKS : A CBIR APPROACH

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## Step 1 : Content-based image retrieval system

- Goal : Find the best image in our database for a comparison with the query
- Method :
  1. Find the 10 most similar images with a dot product using the descriptors explain below. Research is accelerated with a KD-Tree approach
  2. Reorder these 10 candidates in order to find the best candidate. Define an homography between the image query and each candidate in order to found the best homography

## Descriptors used based on VGG19 [1]

- Two sizes used : training images size or based on a kernelization step like [2]
- Three vectors are analyzed based on the output of three layers: last convolutional layer  $\mathcal{C}_5$  with a output lenght of 512 and the fully-connected layers  $\mathcal{C}_6$  and  $\mathcal{C}_7$  with a output lenght of 4096 for both
- A mean or max pooling have to be apply in the case of  $\mathcal{C}_5$  when we used the standard training images size and the three outputs in case of kernelized approach

## Datasets

Queries : (Total : 2,346 images)



Database: (Total : 154,558 images)

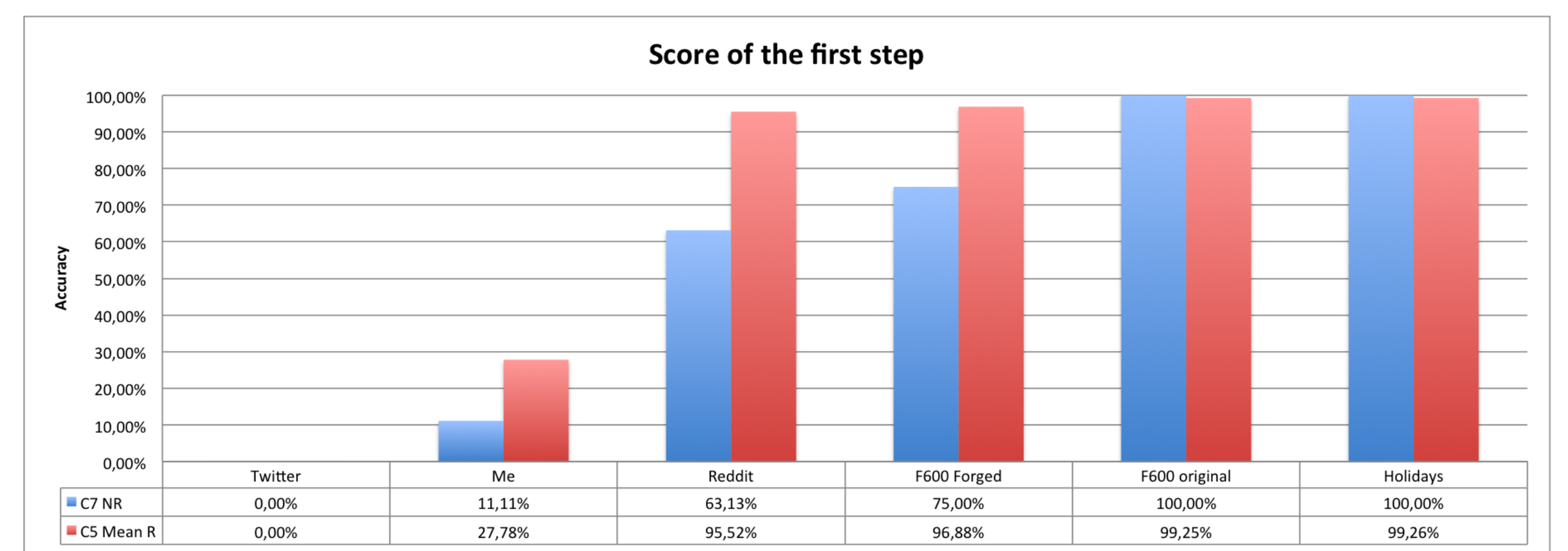
- Twitter : 152,754 + 16
- Me [5] : 310
- Reddit : 128
- F2000 [6] : 1,300
- SATS-130 [7] : 50



## Example



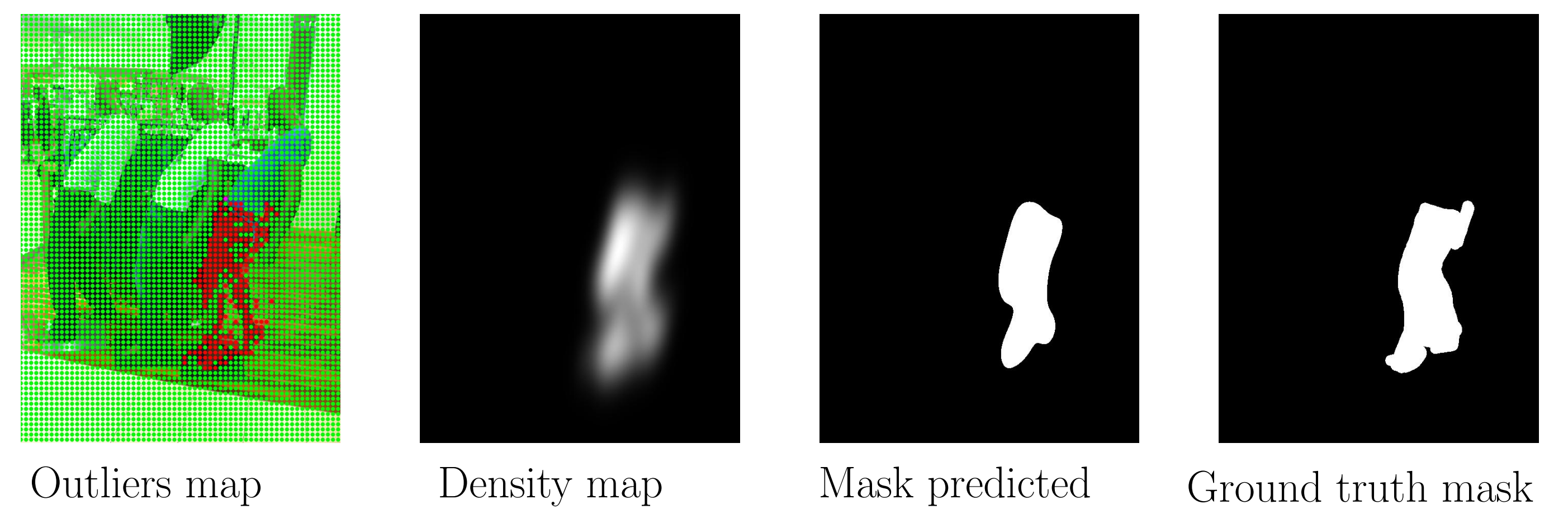
## Results of the first step



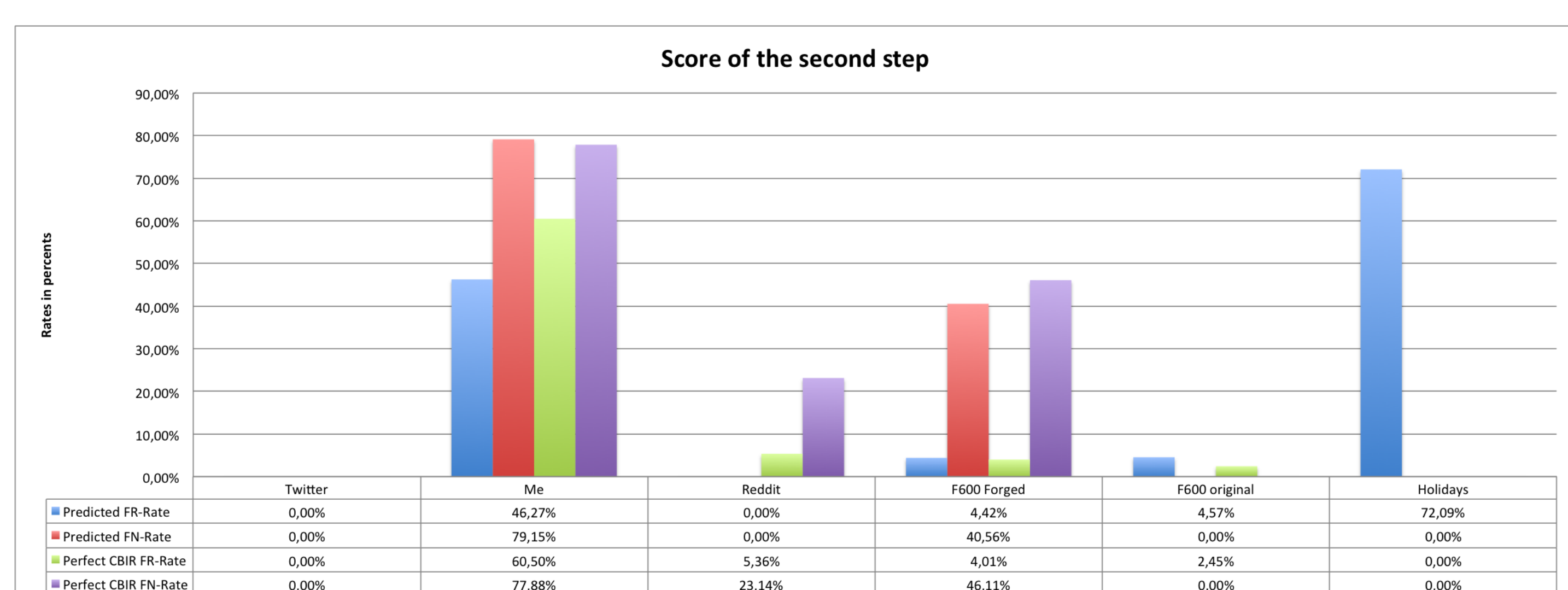
## Step 2 : Homography estimation

- Goal : compare the two images and find the forged area if there is one
- Method :
  1. Match keypoints from the images by similarity.
  2. Define an homography based on RANSAC [8] and find the outliers which correspond to matching not verifying the homography
  3. Define a density map based on the list of outliers and binarize the map with a known threshold.

## Example



## Results of the second step



## Refs

- [1] Simonyan, K., & Zisserman, A. (2014). Very deep convolutional networks for large-scale image recognition. arXiv preprint arXiv:1409.1556.
- [2] Tolias, G., Sicre, R., & Jégou, H. (2015). Particular object retrieval with integral max-pooling of CNN activations. arXiv preprint arXiv:1511.05879.
- [3] Amerini, I., Ballan, L., Caldelli, R., Del Bimbo, A., Del Tongo, L., & Serra, G. (2013). Copy-move forgery detection and localization by means of robust clustering with J-Linkage. Signal Processing: Image Communication, 28(6), 659-669.
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- [5] Christina Boididou, Symeon Papadopoulos, Duc-Tien Dang-Nguyen, Giulia Boato, Michael Riegler, Stuart E. Middleton, Katerina Andreadou, and Yiannis Kompatsiaris. Verifying multimedia use at mediaeval 2016. In Working Notes Proceedings of the MediaEval 2016 Workshop, 2016.
- [6] Amerini, I., Ballan, L., Caldelli, R., Del Bimbo, A., & Serra, G. (2011). A SIFT-based forensic method for copy-move attack detection and transformation recovery. IEEE Transactions on Information Forensics and Security, 6(3), 1099-1110.
- [7] Christlein, V., Riess, C., & Angelopolou, E. (2010, December). On rotation invariance in copy-move forgery detection. In Information Forensics and Security (WIFS), 2010 IEEE International Workshop on (pp. 1-6). IEEE.
- [8] Fischer, M. A., & Bolles, R. C. (1981). A paradigm for model-fitting with applications to image analysis and automated cartography.