Spotting the Difference: Context Retrieval and Analysis for Improved Forgery Detection and Localization

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Introduction

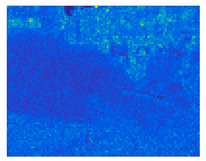
- We leverage the power of wide-scale image search to find contextual clues in related media. These clues allow us to more accurately detect and localize forgeries in tampered images. We test our method using the Nimble Challenge 2016 dataset[1], provided by NIST, with millions of distractor images provided by RankOne[2].
- We develop and analyze the performance of 4 novel image comparison techniques to extract contextual clues in the presence of synthetic noise and perturbation, to analyze robustness to "noisy clues"
- We benchmark our contextual clue-based methods against well-established traditional PDIF methods from [3]

Images from the NIST NC2016 Forgery Dataset

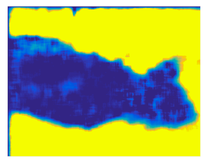
Comparison Algorithms

- PSNR of Gaussian Image Residual (IRPSNR)
- Pseudo-PRNU Patch Comparison (PRNU)
- Structural Similarity Comparison (SSIM)
- HSV Histogram Patch Comparsion (HIST)
- PatchMatch2 [4] Random Comparsion

Original

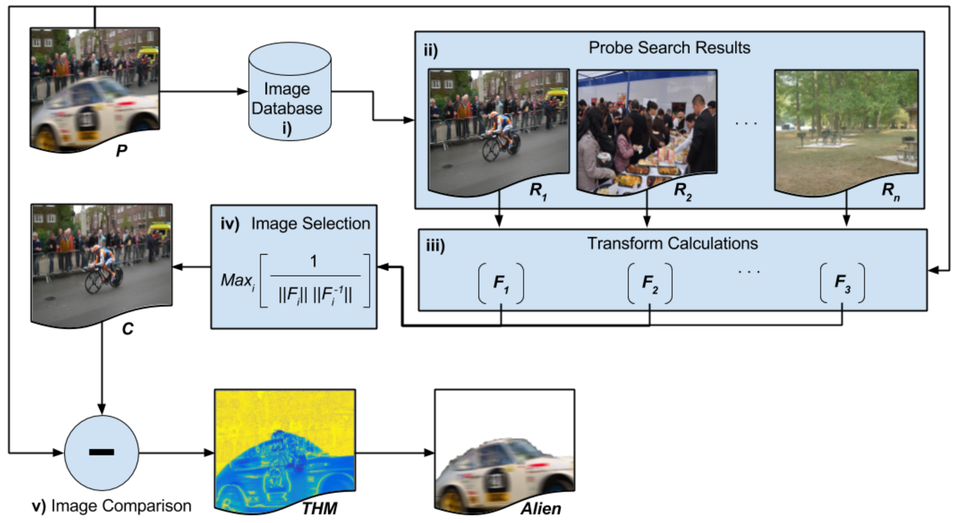


Noise Patterns [5]



Context Comparison

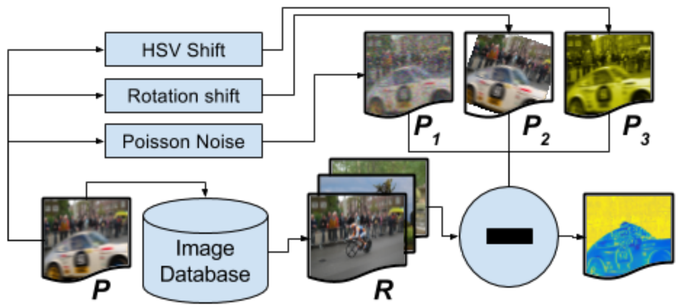
Contextual Comparison Pipeline



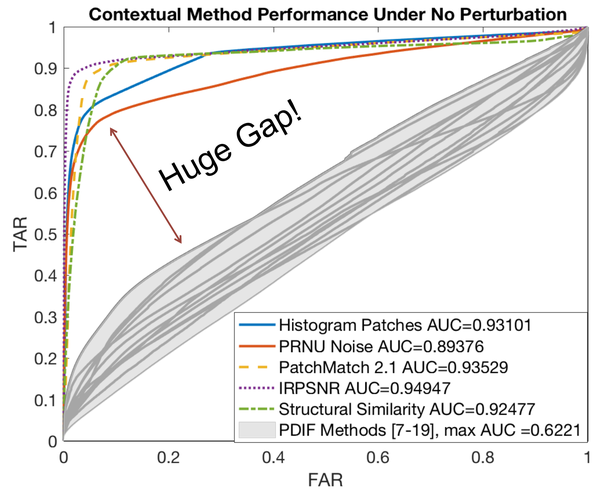
i. An image *P* is is used to query a database of over 1M images
ii. Top N Related resuts R_N are collected for *P*
iii. The transforms between *P* and *R* are calculated using SURF matching and affine homographies
iv. Best non-duplicate image *C* is selected from R_N using the Reciprocal Condition measure
v. Images are compared using 1 of 4 methods to build a Tamper Heat Map (THM)

Perturbation Pipeline

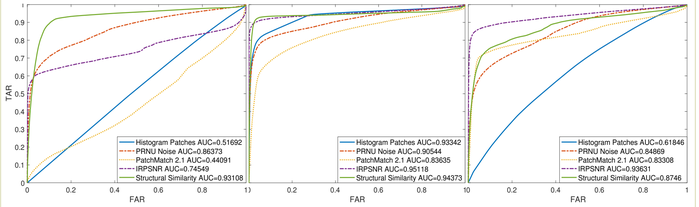
- Each query *P* is perturbed in 3 ways
- Each P_i is used to generate a new THM
- Image comparison methods are analyzed for robustness under perturbation



Results and Observations



HSV Shift | Rotational Shift | Poisson Noise



- Context Comparison greatly out-performs State-of-the-art Passive Image Forensics methods
- SSIM comparison is invariant to HSV color space and rotational shifts, while Noisy images are better tackled by IRPSNR

- [1] NIST, "The 2016 Nimble chal-lenge evaluation dataset,"https://www.nist.gov/itl/iad/mig/nimble-challenge, Jan. 2016.
- [2] http://medifor.rankone.io/
- [3] L. Gaborini, P. Bestagini, S. Milani, M. Tagliasacchi, and S. Tubaro,"Multi-clue image tampering localization," in2014 IEEE WIFS, 2014, pp.125–130.
- [4] C. Barnes et. Al, "Patch-match: Randomized correspondence algorithm for structural imageediting,"ACM TOG
- [5] Mahdian, Babak, and Stanislav Saic. "Using noise inconsistencies for blind image forensics." IVC 27, no. 10 (2009): 1497-1503.