Source Camera Attribution With A Collection Of Seam-Carved Images

Samet Taspinar, Manoranjan Mohanty, Nasir Memon

CENTER FOR CYBER SECURITY

NYU ABU DHABI | جامعة نيويورك أبوظبي

MOTIVATION AND OBJECTIVE

- PRNU based source camera attribution can find the camera of an anonymous image. However, for a forced seam carved image, this scheme fails. We show that camera attribution can be made using multiple seam-carved images.

Social Media

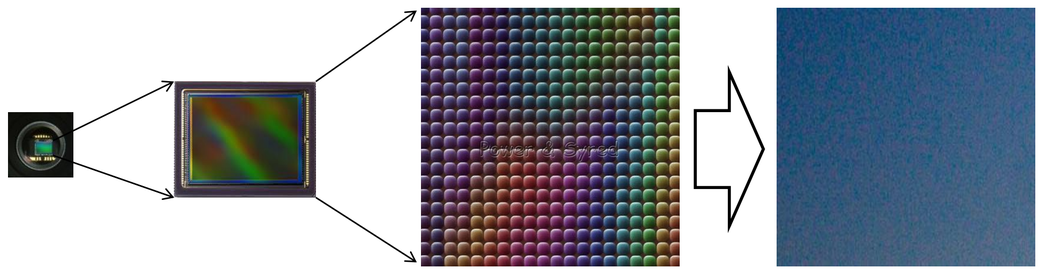
Anonymous Image

(i) This Camera Took?

(ii) Which Camera Took?

APPROACH: PRNU BASED METHOD

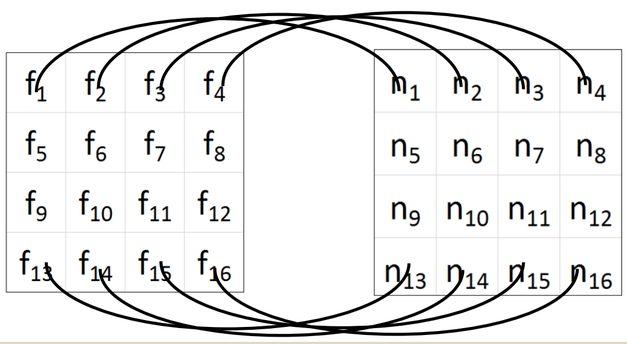
- Every camera has a unique PRNU (Photo Response Non Uniformity) noise that can act as fingerprint.



Sensor Array PRNU Noise

- Finding exact PRNU difficult. Fingerprint can be found from a set from estimated PRNU of a set of video frames.

DEFEATING PRNU SCHEME



- Breaking pixel by pixel alignment
- e.g. Seam Carving

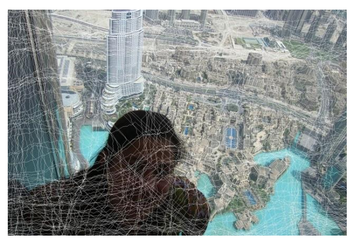
SEAM CARVING

- Content aware image resizing
- Seam: Path of pixel
- Based on energy: Content based Seam Carving

- Does it provide anonymity? -No
- Big uncarved blocks

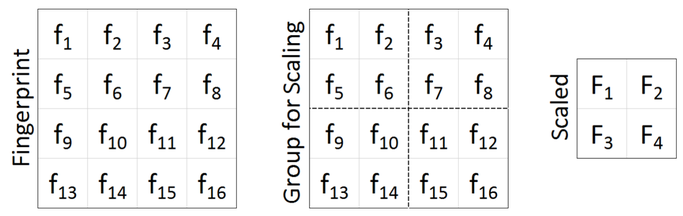
FORCED SEAM CARVING

- Random seams (Bayram et.al)
- No 50 X 50 uncarved block (Dirik et. al.)

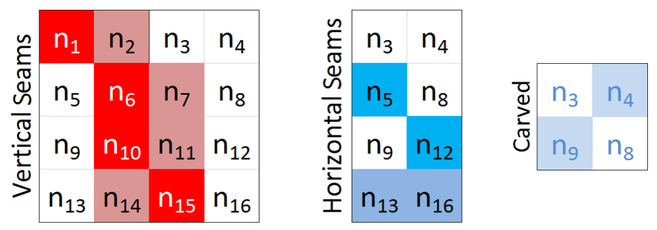


OUR CONTRIBUTION

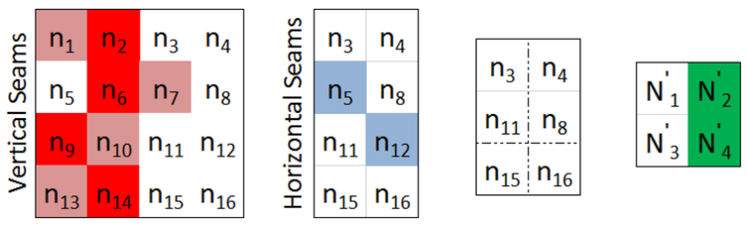
- Showed that attribution can still be done when multiple images exist
- Each image has some aligned pixels
- Multiple seam carved images results in more alignment



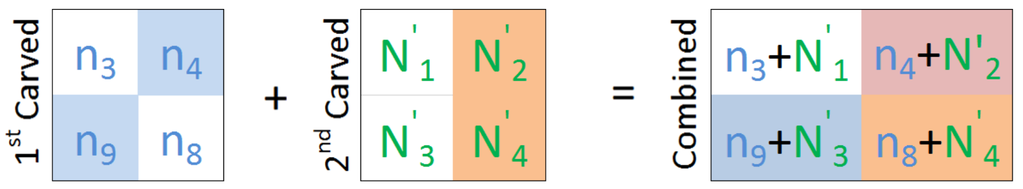
- Scaling fingerprint



- PRNU Noise 1
- n3, n9 are still aligned

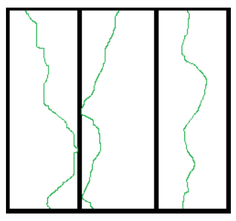


- PRNU Noise 2
- N2', N4' are still aligned
- Combination



EXPERIMENTS AND RESULTS

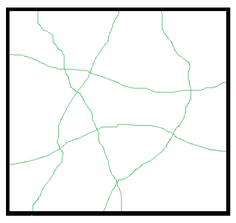
- RsFS



RsFS	#seams				
#images	64	128	256	512	vary
1	1094	444	200	35	134
5	4743	1819	759	128	612
10	7707	3250	1454	219	1233
25	17263	6703	3021	451	2483
50	27516	10813	4948	721	4872
100	39288	15593	6943	1025	8167

- 2+ images needed when 512 seams removed

- RxFS



RxFS	#seams				
#images	64	128	256	512	vary
1	24.6	2.0	-0.2	0.7	0.6
5	120.5	4.1	0.1	-0.4	0.8
10	160.9	7.7	0.0	-0.1	1.3
25	477.1	14.9	0.6	0.0	3.0
50	835.7	33.9	0.6	-0.2	4.8
100	1765.4	58.3	0.5	-0.1	8.8

- 3-5 images needed when 64 seams removed
- 100+ images needed when 128 seams removed