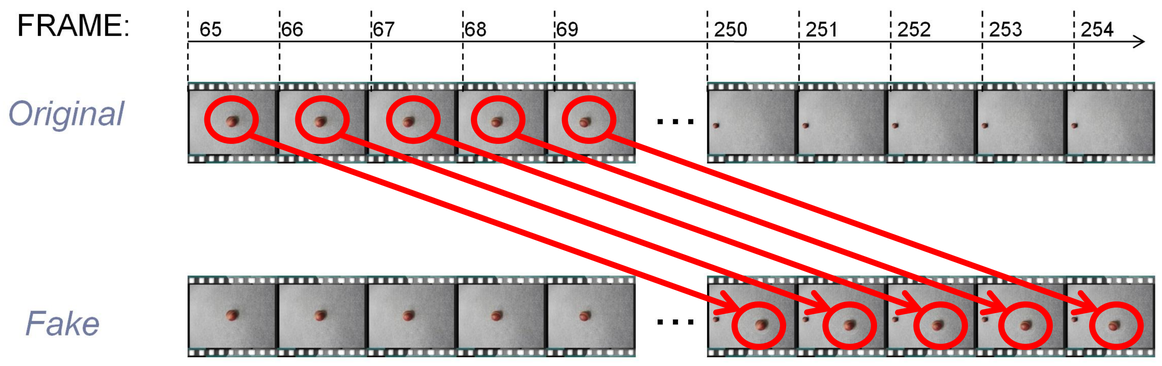
Luca D'Amiano

Tutor: prof. Giovanni Poggi

XXX Cycle - II year presentation

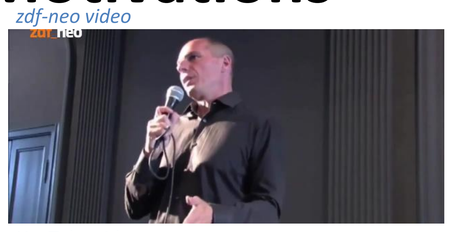
Copy move Video forgery detection

Context: copy-move video forgery

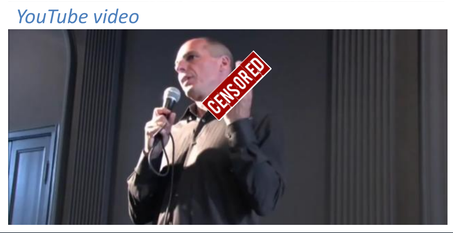


Motivations

zdf-neo video

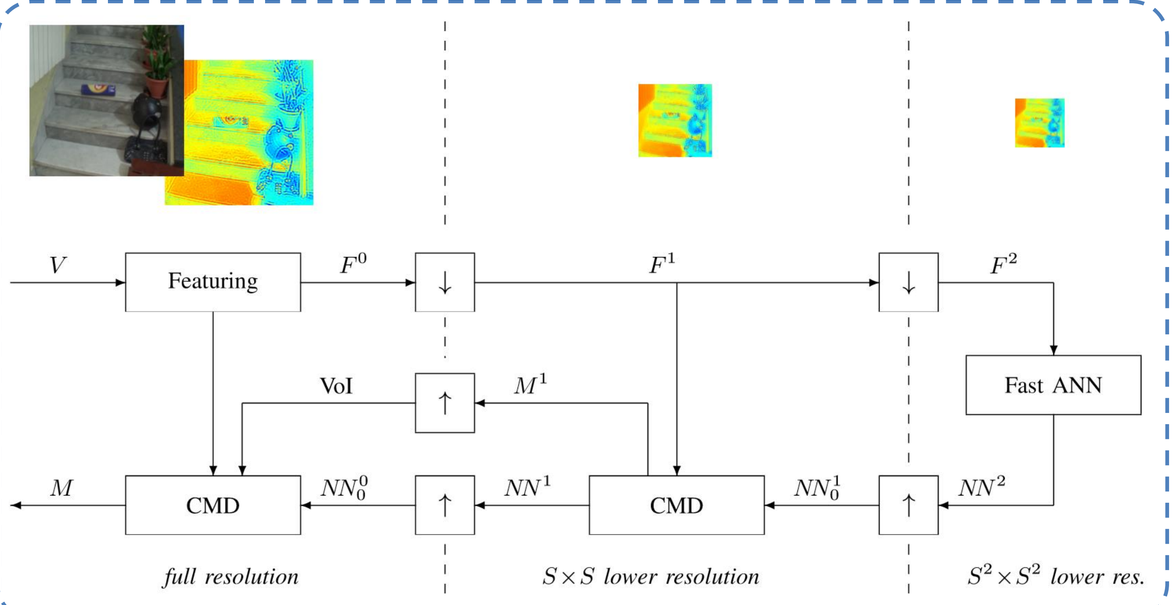


YouTube video



- Anyone can easily modify the appearance and content of digital images and videos
- Forgeries can be used to falsify evidence before a court of law, perpetrating frauds or discrediting people
- Increasing interest in the scientific community towards the detection and localization of video forgeries

PatchMatch-based Algorithm for Video Copy-Move Detection and Localization



CMD

Features

$$f(n,m) = \int_0^{\infty} \rho R^*_{n,m}(\rho) \times \left[\frac{1}{\sqrt{2\pi}} \int_0^{2\pi} I(\rho,\theta) e^{-jm\theta} d\theta \right] d\rho$$

$$R_{n,m}(\rho) = \begin{cases} \sqrt{c_n} \sum_{h=0}^{\frac{n-|m|}{2}} \frac{(-1)^h (n-h)!}{h!\left(\frac{n+|m|}{2}-h\right)!\left(\frac{n-|m|}{2}-h\right)!} \rho^{n-2h}, & \rho \le 1 \\ 0, & otherwise \end{cases}$$

$n - |m|$ is nonnegative and even

$$g(t) = \begin{cases} \frac{1}{\sqrt{2}} |f(t) + f(-t)| & t > 0 \\ |f(t)| & t = 0 \\ \frac{1}{\sqrt{2}} |f(t) - f(-t)| & t < 0 \end{cases}$$

Matching

- A stochastic iterative fast matching algorithm
- Alternates propagation and random search steps
- Quick convergence to an approximate (but accurate) and smooth NN field

Post-Processing

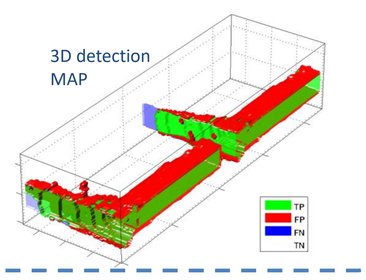
- Offset regularization (removal of outliers)
- Local linear fitting
- Thresholding based on fitting error
- Morphological filtering

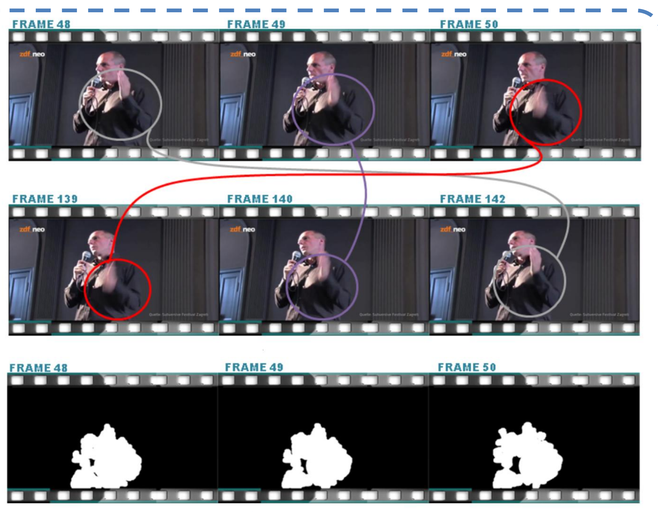
Results

Plain copy-move

original frame / copy-moved frame

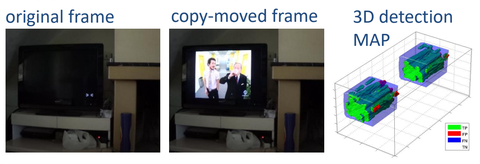
3D detection MAP





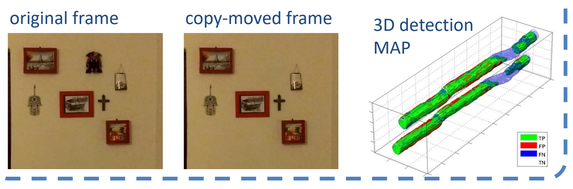
Copy-move with compression

original frame / copy-moved frame / 3D detection MAP



Copy-move with 45°rotation

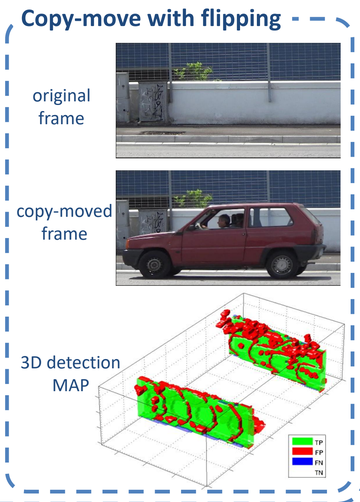
original frame / copy-moved frame / 3D detection MAP



	basic algorithm				basic flip-invariant				fast algorithm				fast flip-invariant			
video	det.	f.a.	F	time	det.	f.a.	F	time	det.	f.a.	F	time	det.	f.a.	F	time
1	✓		0.97	12.3	✓		0.94	12.5	✓		0.89	5.1	✓		0.83	5.5
2	✓		0.95	13.0	✓	✓	0.82	12.9	✓		0.83	5.8	✓		0.54	5.9
3	✓		0.81	12.8	✓		0.59	13.6	✓		0.16	5.6	✓		0.00	6.3
4	✓		0.97	12.3	✓		0.92	12.0	✓		0.78	4.9	✓		0.62	5.7
5	✓		0.54	13.1	✓		0.55	13.9	✓		0.25	5.9	✓		0.15	6.5
6	✓	✓	0.88	12.0	✓		0.88	13.3	✓	✓	0.77	5.2	✓	✓	0.76	7.2
7	✓		0.91	14.8	✓		0.85	15.0	✓		0.80	5.5	✓		0.66	6.5
8	✓		0.91	15.3	✓		0.84	16.4	✓		0.69	6.2	✓		0.49	7.1
9	✓		0.94	13.3	✓		0.92	14.2	✓		0.92	5.5	✓		0.91	6.3
10	✓		0.92	12.6	✓		0.87	13.2	✓		0.81	5.6	✓	✓	0.75	5.6
11	✓	✓	0.92	12.0	✓		0.91	13.1	✓		0.01	6.4			0.00	6.4
12	✓		0.92	17.8	✓		0.87	13.9	✓		0.92	11.4	✓		0.88	10.4
13	✓		0.95	14.5	✓		0.94	13.1			0.00	6.2	✓		0.95	10.1
14	✓		0.94	16.2	✓		0.93	13.8	✓		0.93	10.4	✓	✓	0.91	10.6
15	✓	✓	0.90	16.1	✓	✓	0.83	14.0	✓	✓	0.21	7.0	✓	✓	0.70	6.4
Σ, μ	15	3	0.89	13.9	15	2	0.84	13.7	14	2	0.60	6.5	14	4	0.61	7.1

Copy-move with flipping

original frame / copy-moved frame / 3D detection MAP



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GRIP Image Processing Research Group

http://www.grip.unina.it/

Uneversità degli Studi di Napoli Federico II

Future developments

During the third year of activity we will use PatchMatch to perform the co-registration of biomedical images.

The goal is to find the pointwise transformation T which minimizes the cost functional:

$$C = D\left[I_f, I_m(T)\right] + R(T)$$

where I_f *and* I_m are the source images, *D* measures distortion, and *R* is a regularization term.

We already obtained good results for global linear transforms, we are now considering elastic transforms, that is, generic deformations.