Forensic Media Analysis
Mini-STEM School
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Disclaimer

The products, software and images presented in these slides are only mentioned and used as tools and examples for forensic analysis and the intention of this presentation is solely educational.
What’s media forensics?

Media forensics is scientific study into the collection, analysis, interpretation, and presentation of audio, video, and image evidence:

- obtained during the course of judicial investigations and litigious proceedings
- suitable to public discussion and debate.
How do we work?

- Occurrence of the crime
- Recovery
- Analysis
- Interpretation
- Presentation

Occurrence of the crime
How do we work?

Nothing should be added, lost, damaged or obliterated in the recovery process.
How do we work?

Use scientific validated methods to ensure:
- accuracy & precision
- repeatability
- reproducibility

1. Occurrence of the crime
2. Recovery
3. Analysis
4. Interpretation
5. Presentation
How do we work?

- Occurrence of the crime
- Recovery
- Analysis
- Interpretation
- Presentation

Respect the principles of:
- Individuality
- Comparison
How do we work?

Working within an ethical framework, a forensic scientist should fully disclose and present impartial evidence which is readily understandable and neither overstated nor understated.
Image Analysis Examples
Forensic Enhancement
Image Analysis Examples
Forensic Authentication
Forensic image analysis in real cases, media and research integrity investigations

The most common image editing/manipulation techniques that were found in research papers consist in:

1) Copy + Paste (+ Rescale) of the original image/photo
2) Image reconstruction (usually for schematics, plans)
3) Clone inside the same image
4) Clone + B/C adjustments to mask the visible cloning traces
5) Advanced editing techniques
Does this image look suspicious? Please explain your answer(s).
ARIO-05-A.jpg after → Colors → Auto → Equalize

Image inconsistencies due to a local editing (copy/paste from another image)
Image inconsistencies due to a local editing (copy/paste from another image)
ARIO-05-A.jpg after \( \Rightarrow \) CFA Map analysis

Image inconsistencies due to a local editing (copy/paste from another image)
ARIO-05-A.jpg after \( \Rightarrow \) DCT Map analysis

Image inconsistencies due to a local editing (copy/paste from another image)
The anatomy of a forgery

1) Content-Aware example
The lasso selection around the bird
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ARIO-07-B.jpg after Image Error Level Analysis Quality: 0.7

Image inconsistencies due to a local editing (Adobe Photoshop Content-Aware)
The anatomy of a forgery

1) Content-Aware example

2) Clone / Copy+Paste example
ARIO-15-B.bmp

Image

⇒ Copy Move…

Q=1, T=100
ARIO-15-B.bmp

Colors
- Auto
- Equalize

inconsistencies
ARIO-15-D.bmp
(a better image tampering using Blur)

Colors
⇒ Auto
⇒ Equalize
ARIO-18-B.bmp

Image

⇒ Copy Move…

Q=1, T=100
What do you think about this image?
⇒ Image ⇒ Copy Move... ⇒ Q=1, T=10
Practice with some real case reconstructions

⇒ Image ⇒ Copy Move… ⇒ Q=2, T=100
ARIO-35-B.jpg

Image

⇒ Copy Move...

Q=1, T=10
Questioned image submitted for forensic analysis.
Local inconsistencies

Disable Green & Blue Layers
⇒ Colors ⇒ Auto ⇒ Equalize
Clone detection with a specialized forensic system
Forensic image analysis

Conclusion

1) An improvement of image “manipulation” techniques was noticed during the past years.

2) New image analysis techniques were published in peer reviewed journals.

3) Forensic image analysis can be a good asset to detect traces of image tampering in scientific research, media, and judicial proceedings.
Audio Analysis Examples
Noisy recording containing: speech, sirens, windshield wiper, background noise...
Forensic enhanced recording without sirens, windshield wiper, background noise.
The removed sirens, windshield wiper, background noises...
Noisy recording containing: speech, hum, broadband noise...
Forensic enhanced recording without hum, broadband noise...
Two overlapped speakers
One speaker extracted
Noisy recording containing: speech, background music, background noise...
Forensic enhanced recording with attenuated music and noise...
More forensic media analysis includes

- Video authentication
- Audio authentication
- Audio background analysis
- Speaker recognition
- Face recognition, etc.