Introduction to 2D computer vision

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Version 3.2

Artificial Intelligence & Information Analysis Lab

2D Computer vision overview

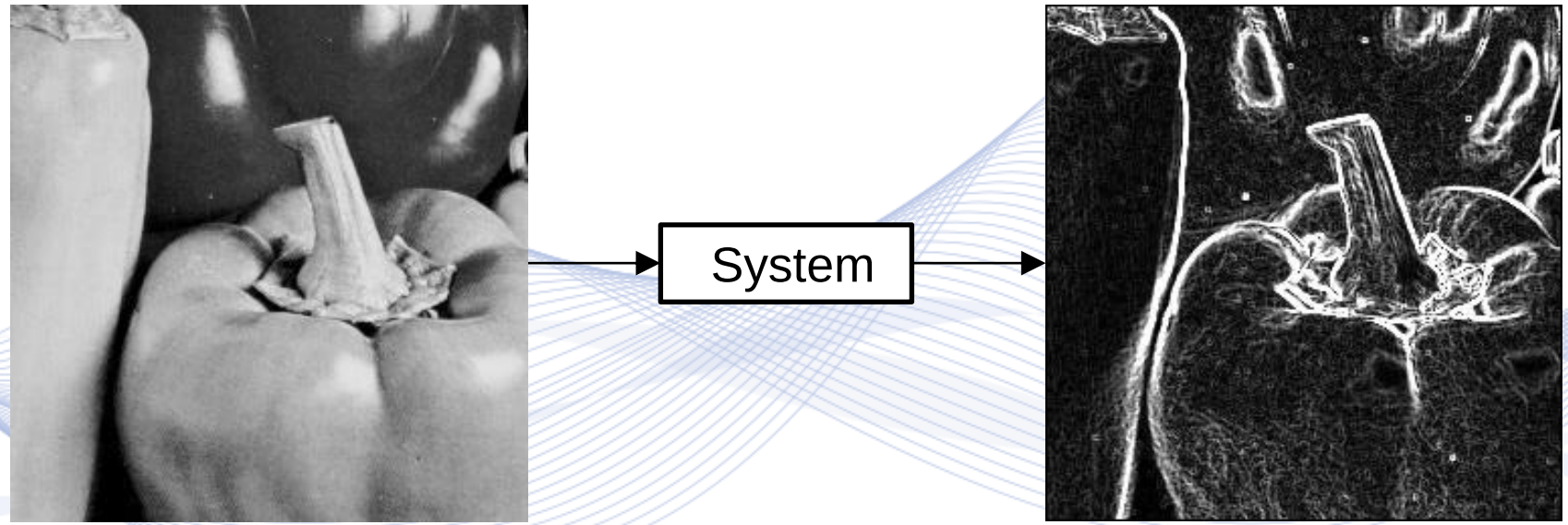
- Image and video acquisition
- Edge detection
- Region segmentation
- Texture description
- Image topology
- Shape description
- Object detection and tracking
- Image registration

- Other terms: ***image analysis, image understanding.***

2D computer vision

Operation on the image plane only.

- Input: 2Dimage output: symbolic description



Images $f(x, y)$ and videos signal $f(x, y, t)$

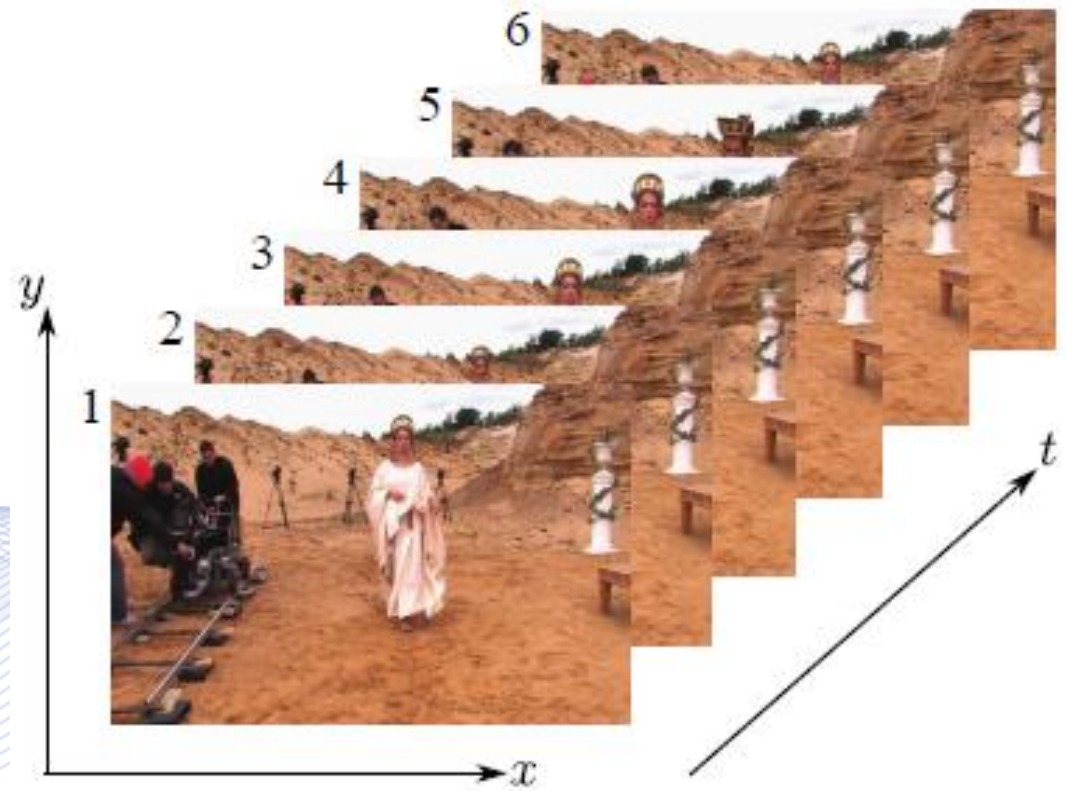
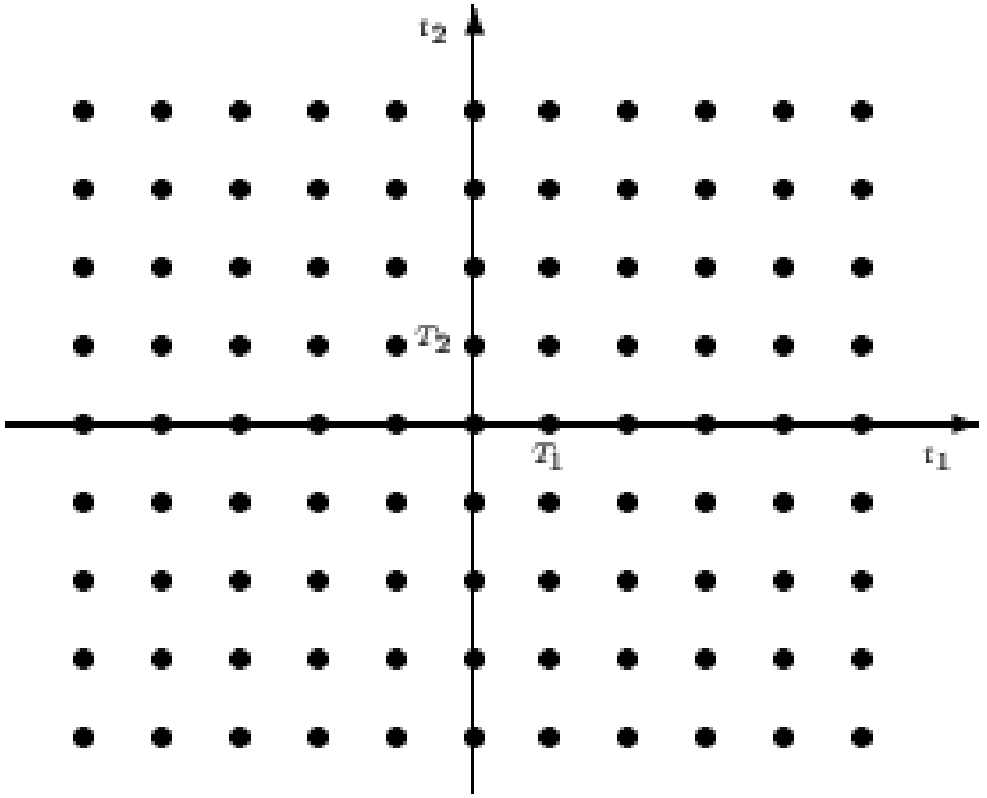
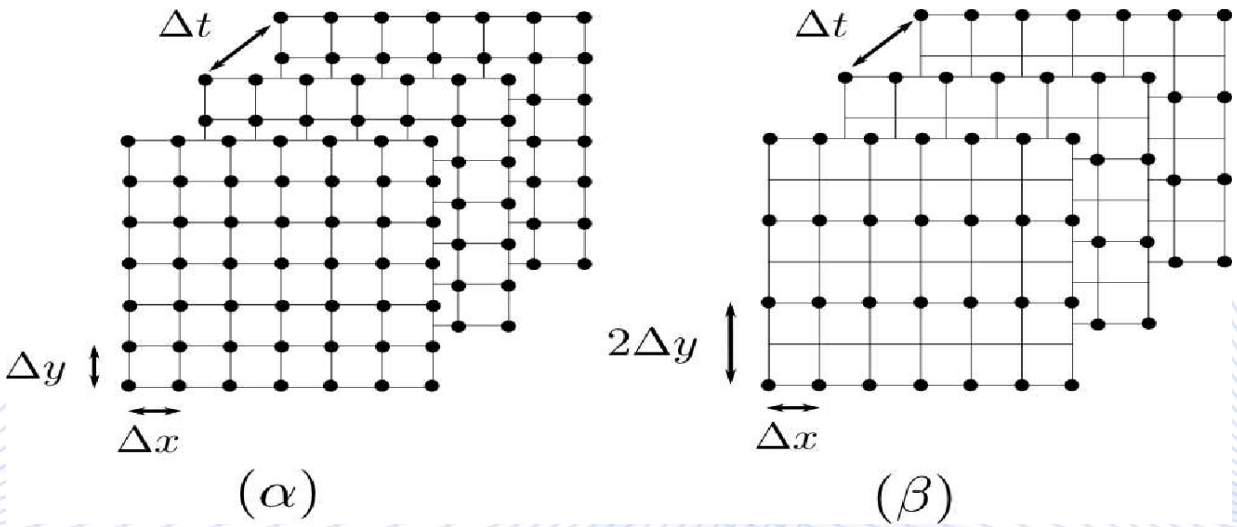


Image sampling



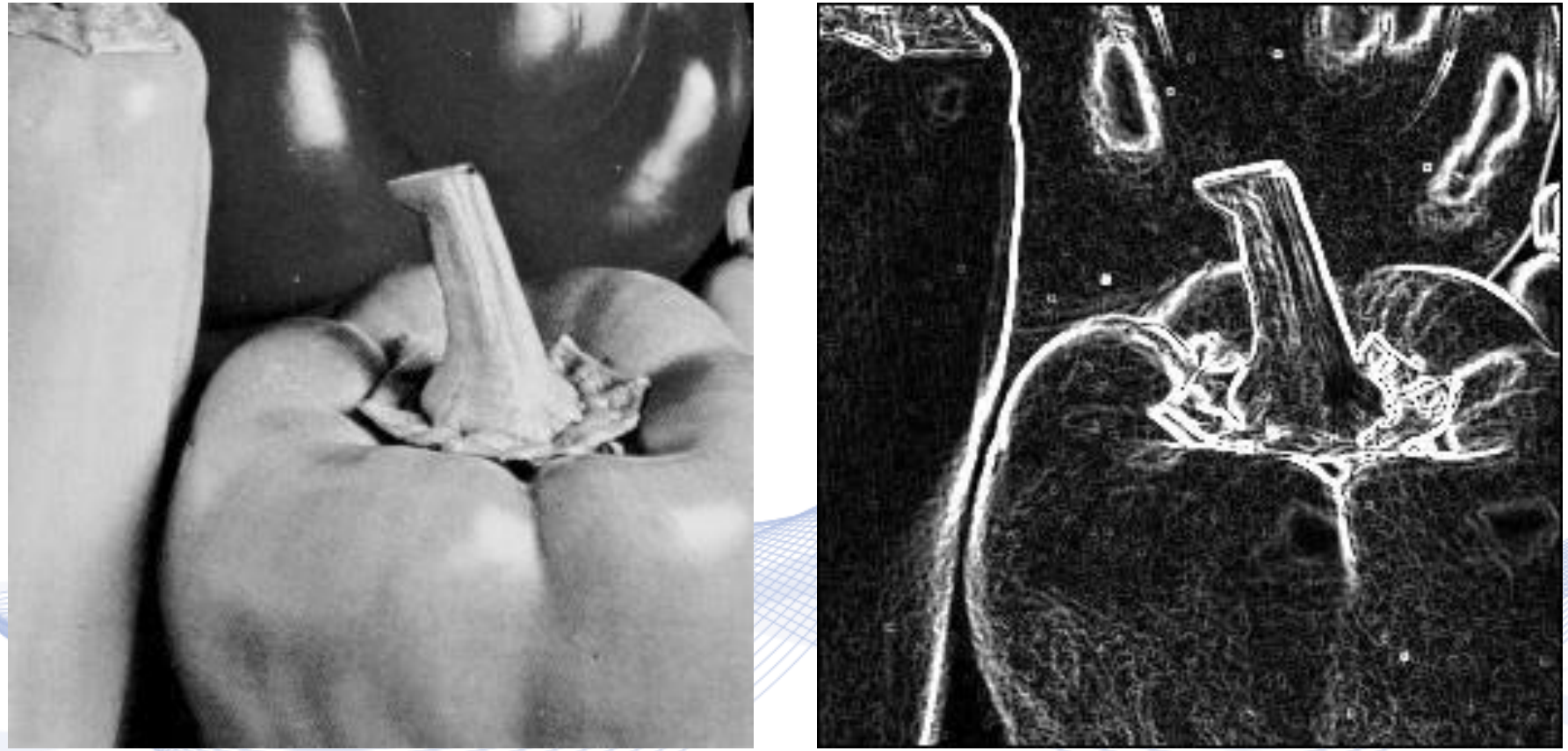
Rectangular image sampling grid.

Video sampling



Sampling grids for: a) progressive and b) 2:1 interlaced video

Edge detection

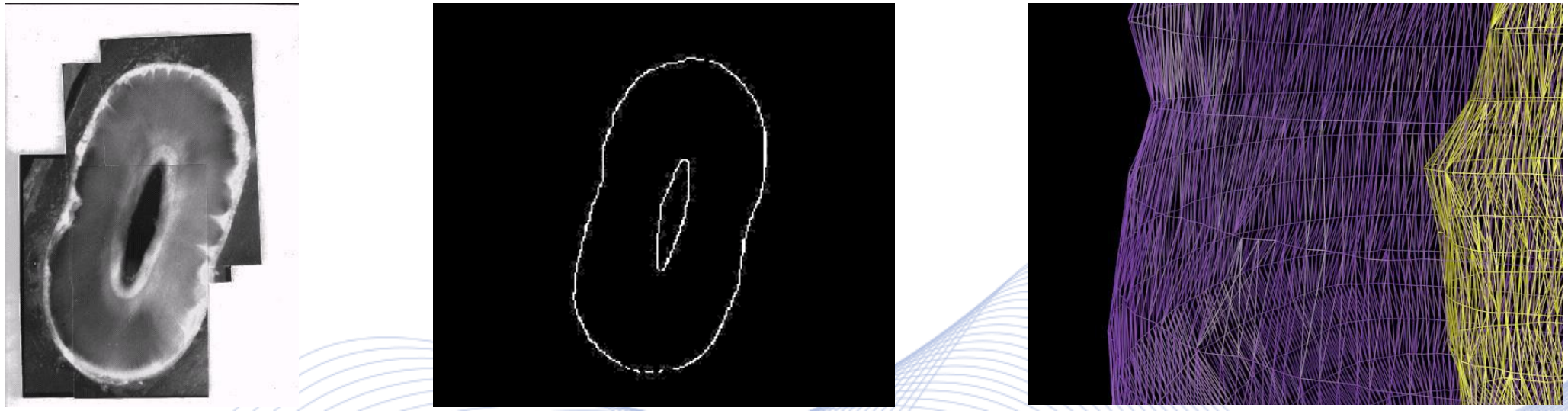


a) Image and b) image edges.

Contour following

Contour following on a tooth cross-section.

Contour following



a) Tooth cross-section mosaicking; b) contour following and c) 3D tooth wireframe.

Region segmentation

Image thresholding.

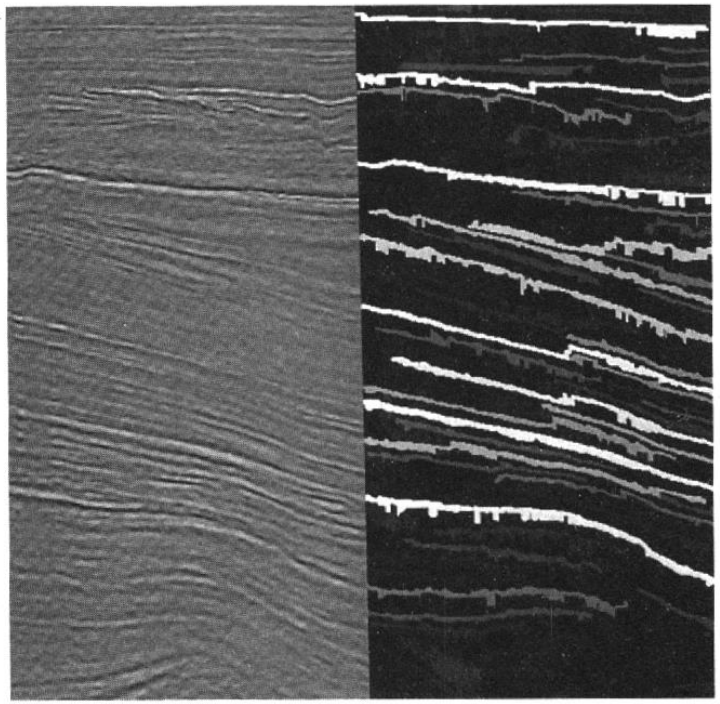
Region segmentation

Foreground and background region segmentation.

Region segmentation

Street scene segmentation [APOLLO].

Texture description

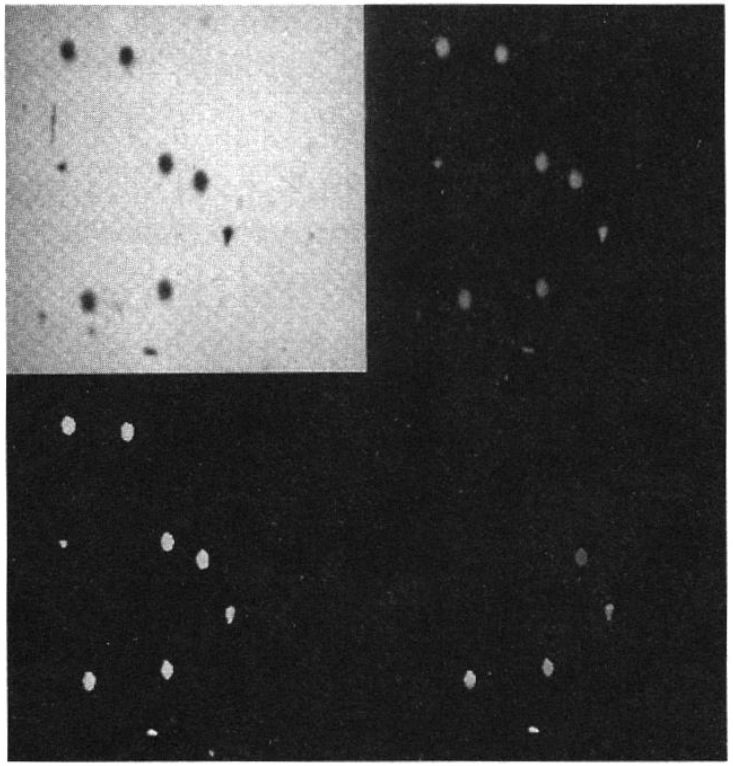


Seismic image with horizontal texture.

Image topology

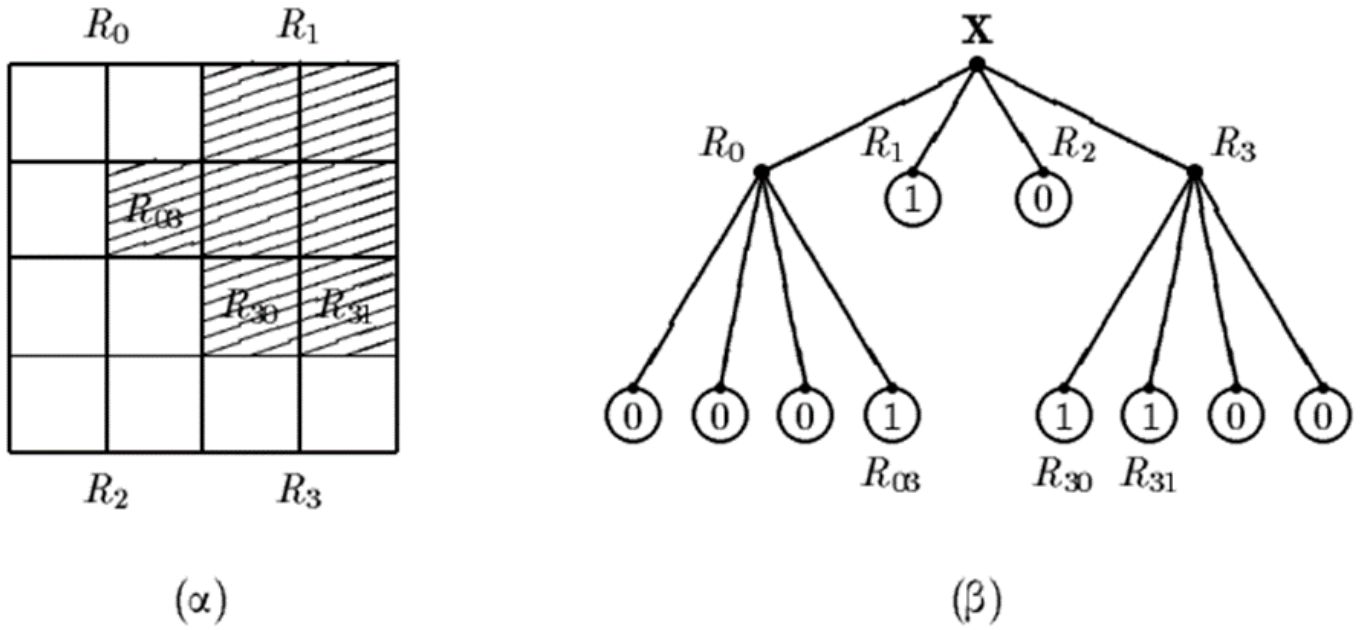
Object holes and connected components.

Image topology



Counting connected components (objects) in a microscopy image.

Shape description

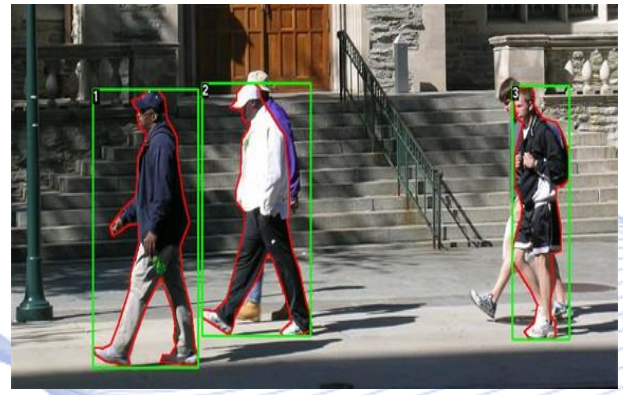


Binary image.

Quadtree representation.

Object detection

- Pedestrian, cars/vans/cyclist, road sign detection
- Current neural detectors are very capable of accurately detecting objects
- SSD, YOLO.

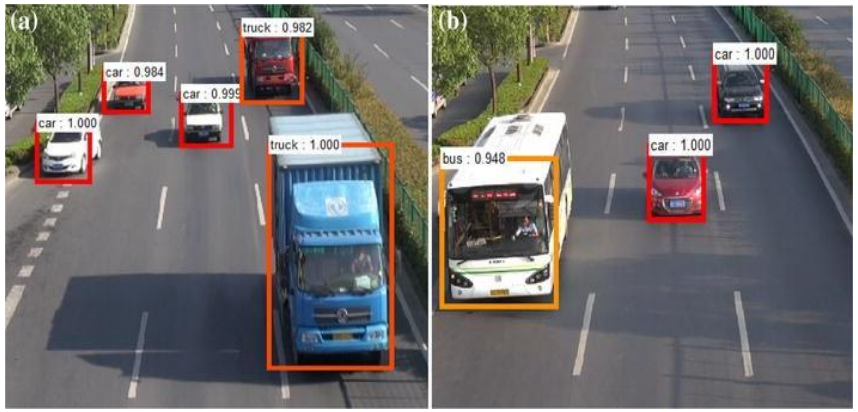


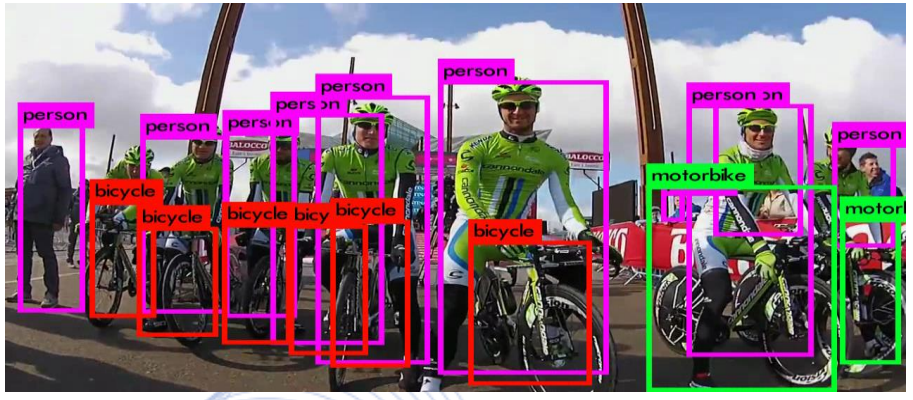
SSD

YOLO

Object detection

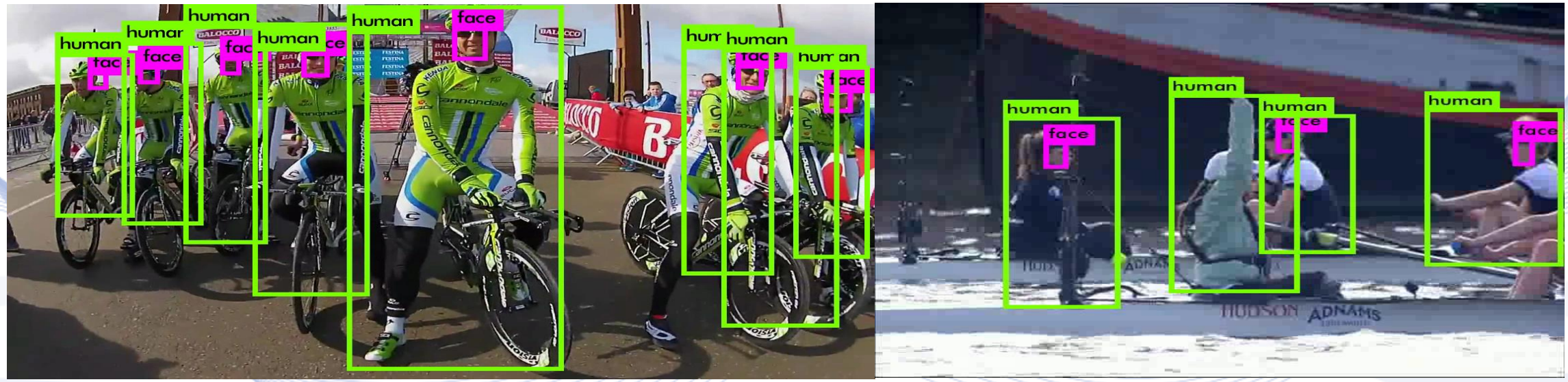
- **But** require domain-specific training or fine-tuning.



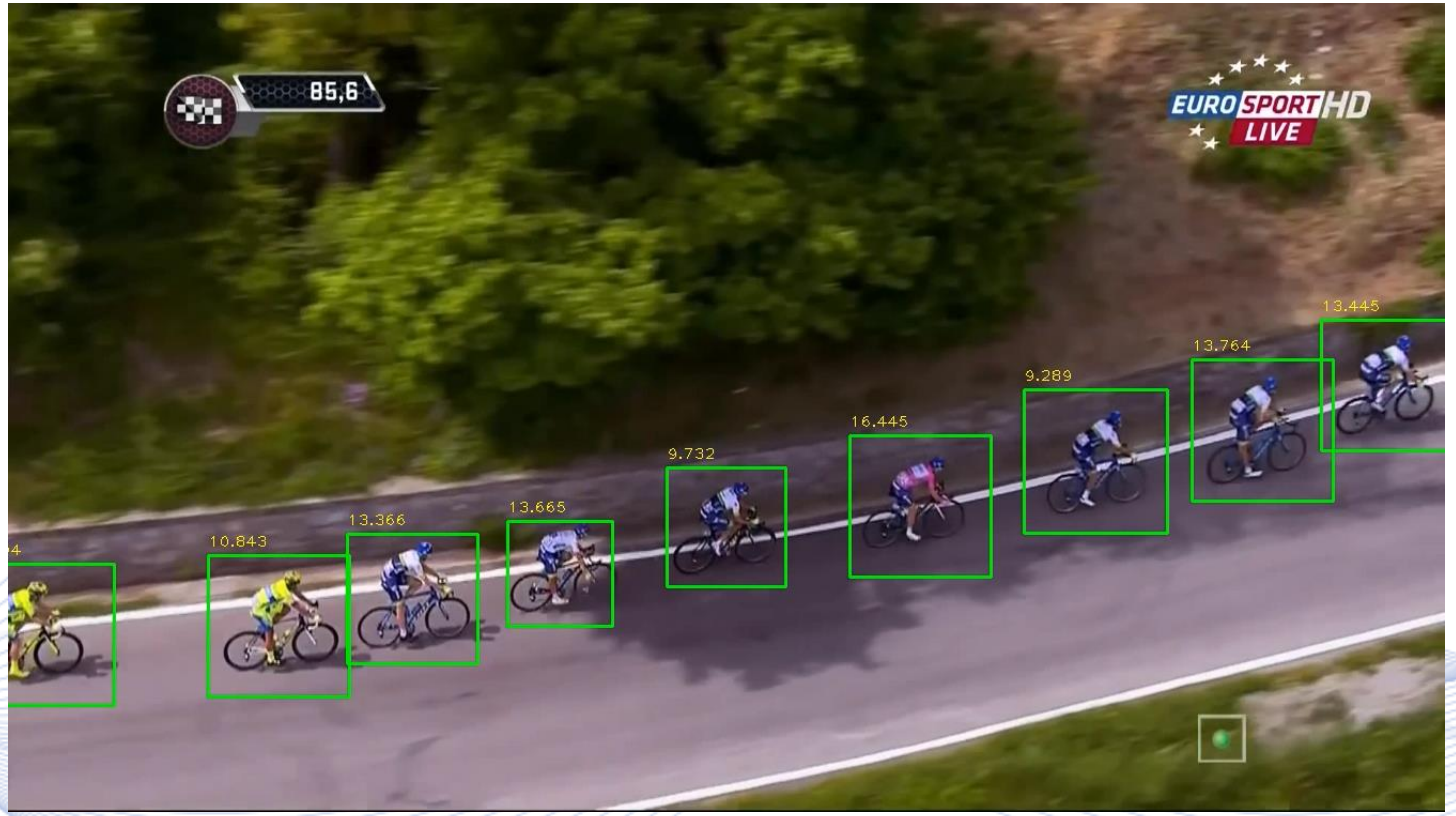


Object detection

- Both can be trained when suitable annotations are available.
  - e.g., YOLO can perform face and human detection, trained on WIDER dataset.

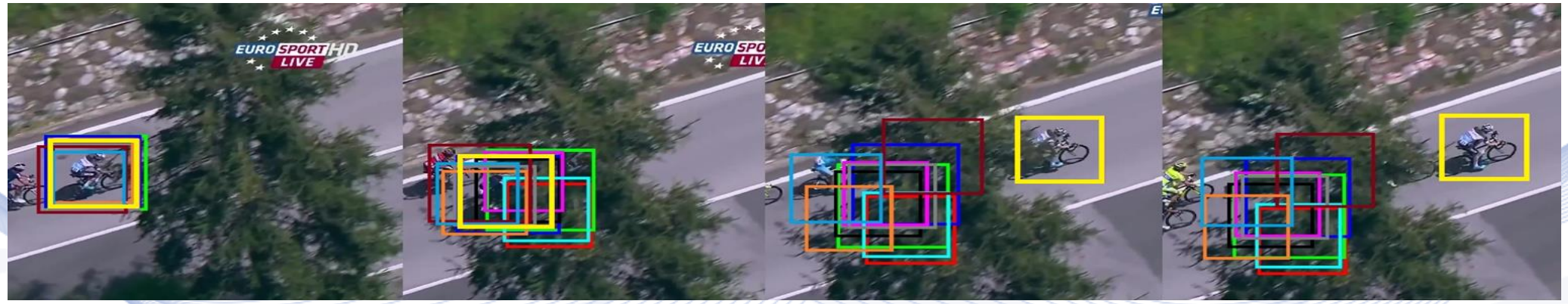


UAV Object detection & tracking



Joint Detection & Tracking

- Target re-initialization by the detector in hard tracking cases when tracking algorithms fail.



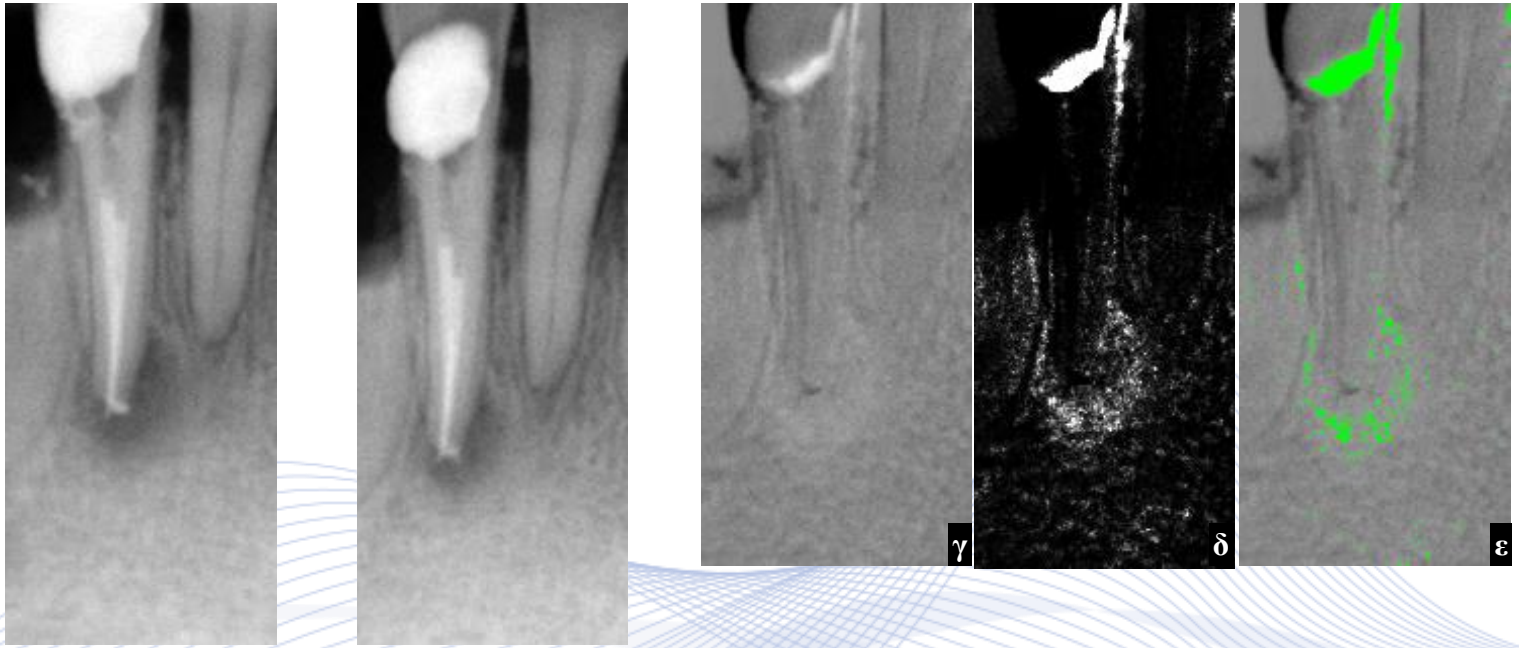
Joint Detection & Tracking

- Target re-initialization by the detector in hard tracking cases when tracking algorithms fail.

2D Image registration

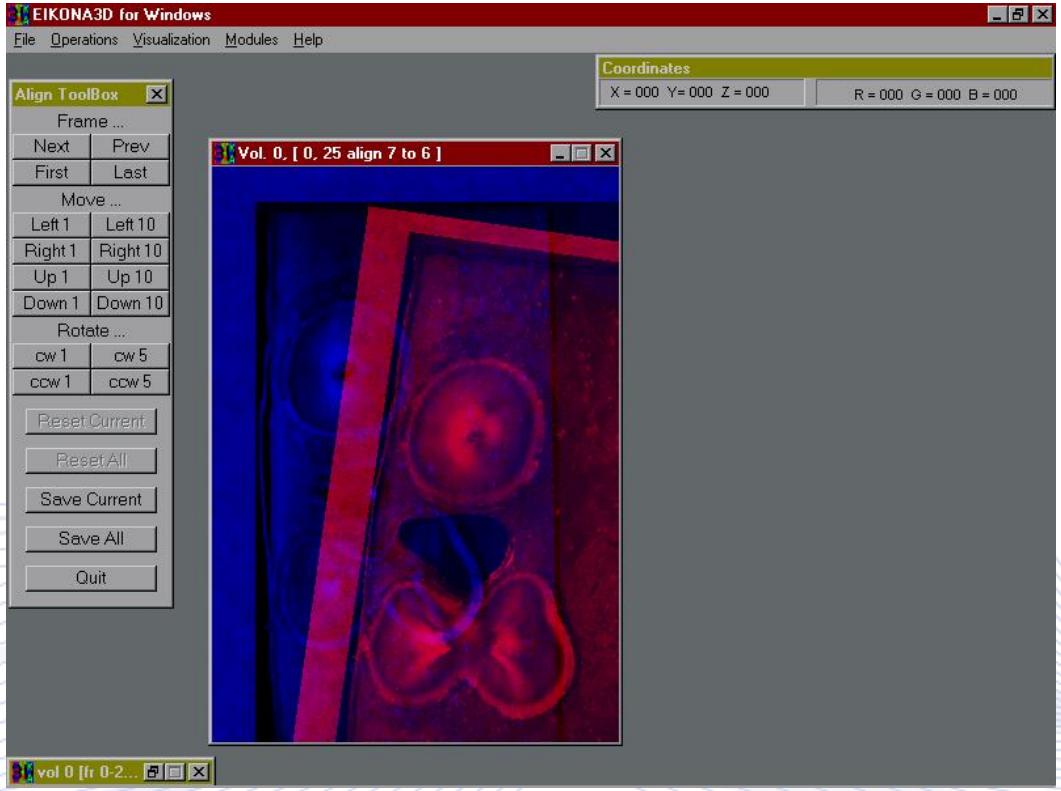
- 2D image registration and mosaicking.

2D Image registration



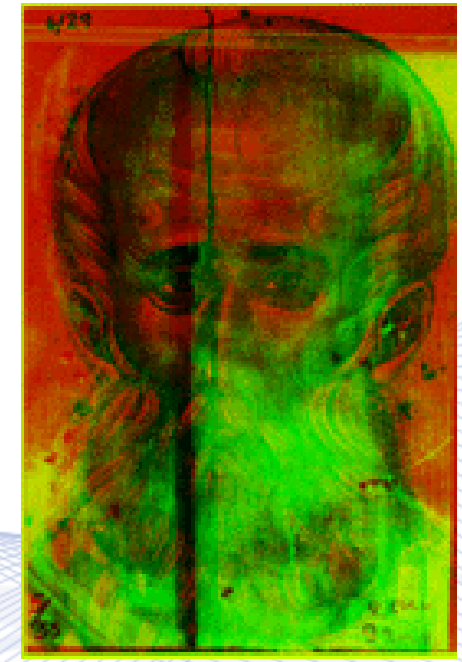
2D image registration and subtractive radiography.

2D Image registration



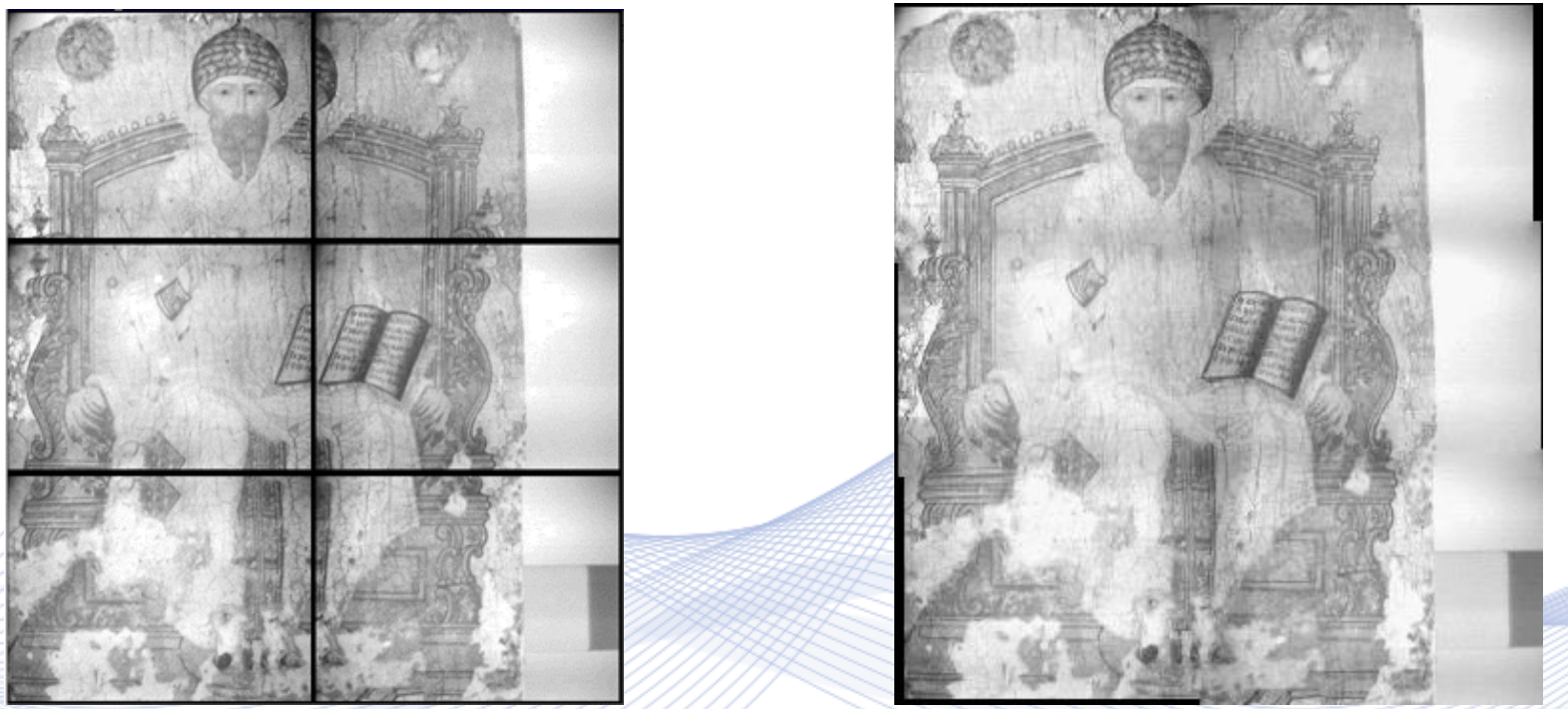
2D image registration.

2D Image registration



2D image registration: visible+xray painting image.

Image mosaicing



a) IR image tiles of a painting; b) mosaiced IR image.

Bibliography

[PIT2021] I. Pitas, “Computer vision”, Createspace/Amazon, in press.
[SZE2011] R.Szelinski, “ Computer Vision ” , Springer 2011
[HAR2003] Hartley R, Zisserman A. , “ Multiple view geometry in computer vision” . Cambridge university press; 2003.
[DAV2017] Davies, E. Roy. “Computer vision: principles, algorithms, applications, learning ”. Academic Press, 2017
[TRU1998] Trucco E, Verri A. “Introductory techniques for 3-D computer vision”, Prentice Hall, 1998.
[PIT2017] I. Pitas, “Digital video processing and analysis ” , China Machine Press, 2017 (in Chinese).
[PIT2013] I. Pitas, “Digital Video and Television ” , Createspace/Amazon, 2013.
[PIT2000] I. Pitas, Digital Image Processing Algorithms and Applications, J. Wiley, 2000.
[NIK2000] N. Nikolaidis and I. Pitas, 3D Image Processing Algorithms, J. Wiley, 2000.
[APOLLO] http://apolloscape.auto/

Q & A

Thank you very much for your attention!

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