



Master in Computer Vision | Barcelona



UNIVERSITAT POLITÈCNICA
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Universitat
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Module: 3D Vision
Project: 3D recovery of urban scenes Session4

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Goal

Reconstruction of 3D scenes from two images (known internal parameters)

Mandatory Tasks:

- Triangulation with the homogeneous algebraic method (2.0)
- Reconstruction from two views:
 - Estimation of the Fundamental and Essential Matrix between two cameras (2.0)
 - Estimate both Camera Matrices (2.0)
 - Computation of reprojection error (0.5)
- Depth map computation using local methods
 - SSD Cost (2.0)
 - NCC Cost (1.0)
 - Adaptive support weights (2.0)

Goal

Reconstruction of 3D scenes from two images (known internal parameters)

Optional Tasks:

- Depth map computation by plane sweep **(+1.5)**
- New view synthesis: using view morphing **(+1.5)**
- Depth map fusion review (old and new) **(+2.0)**

- Organized notebook/code and good code/mathematical notation **(+1.0)**

Assignment

- Code is provided in python in a jupyter notebook.
- Auxiliary functions and algorithms are provided on additional modules.
- Deliver before 9AM of the next lab session.

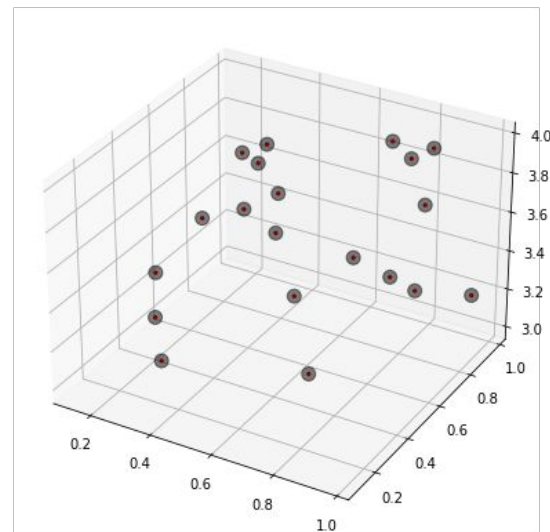
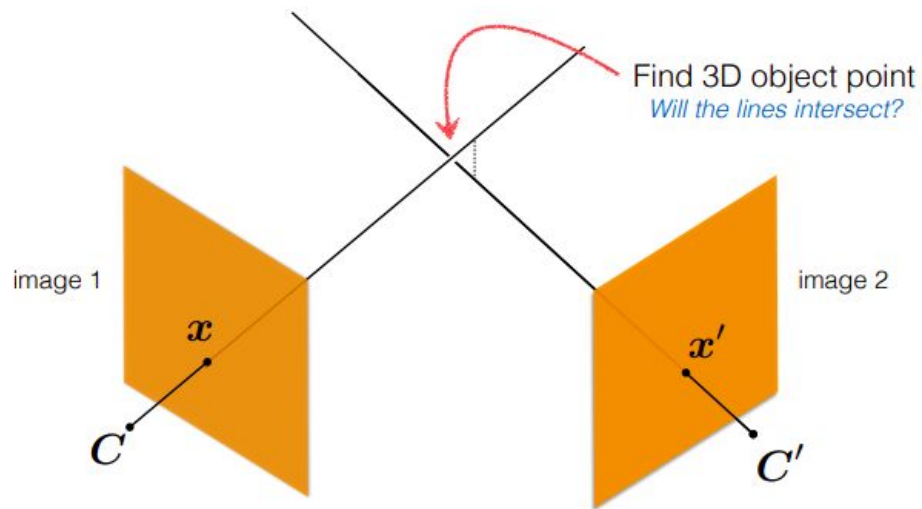
Deliverables

- **Jupyter notebook:** ready to run.
 - Document your code and decisions on markdown.
 - Be clear of what information is assumed/required for each algorithm/operation.
 - Understand the equations do not just reproduce them from the slides.

Report:

- Short report.
- In depth analysis.
- Do not paste code in report. I am interested in analysis and justification.
- Problems and comments.
- You can use the notebook as a report **IFF** you format the notebook appropriately.

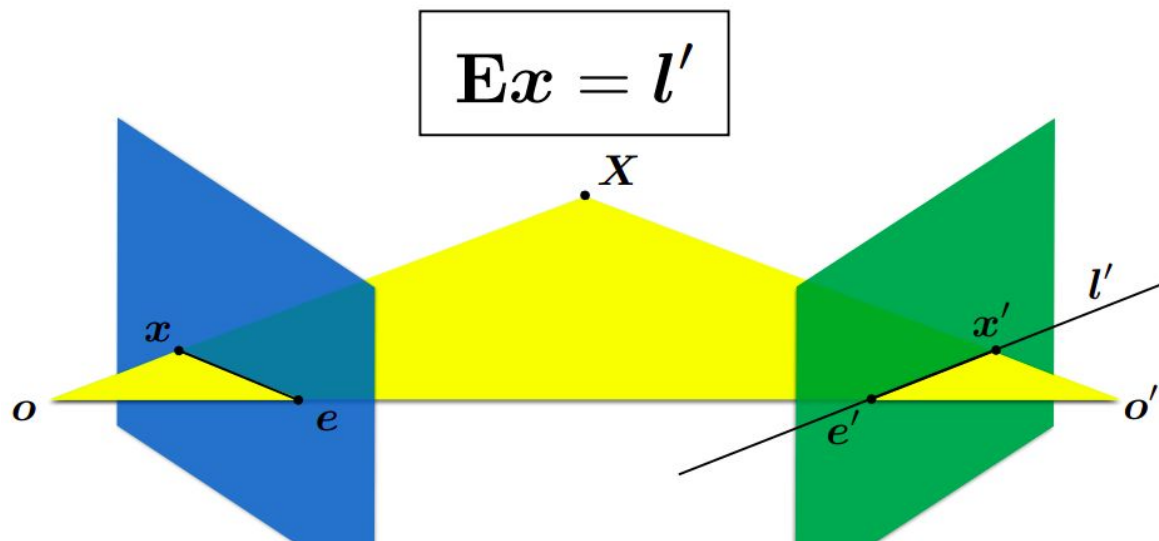
Triangulation



● Ground Truth
● Triangulated

Reconstruction from two views

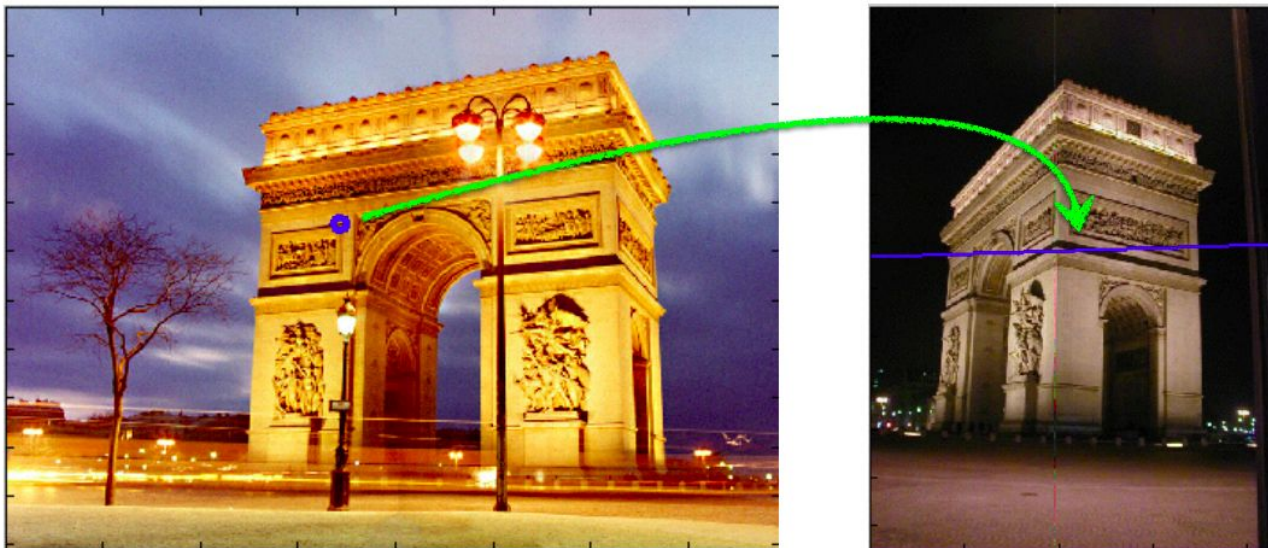
Fundamental/Essential Matrices



1981 by H. Christopher Longuet-Higgins

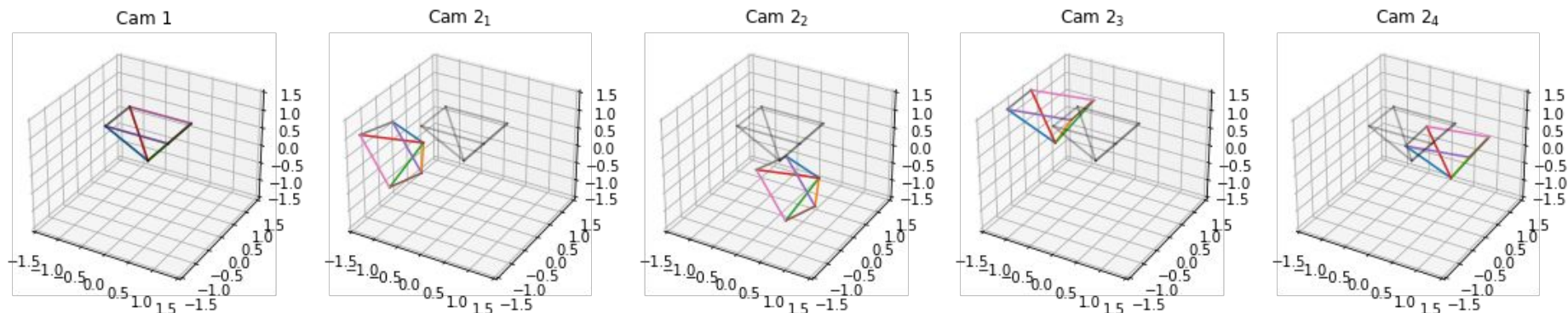
Reconstruction from two views

Fundamental/Essential Matrices



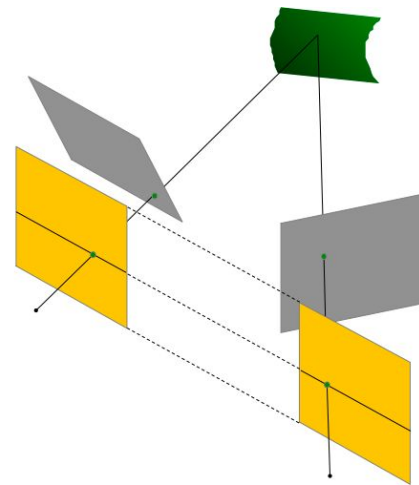
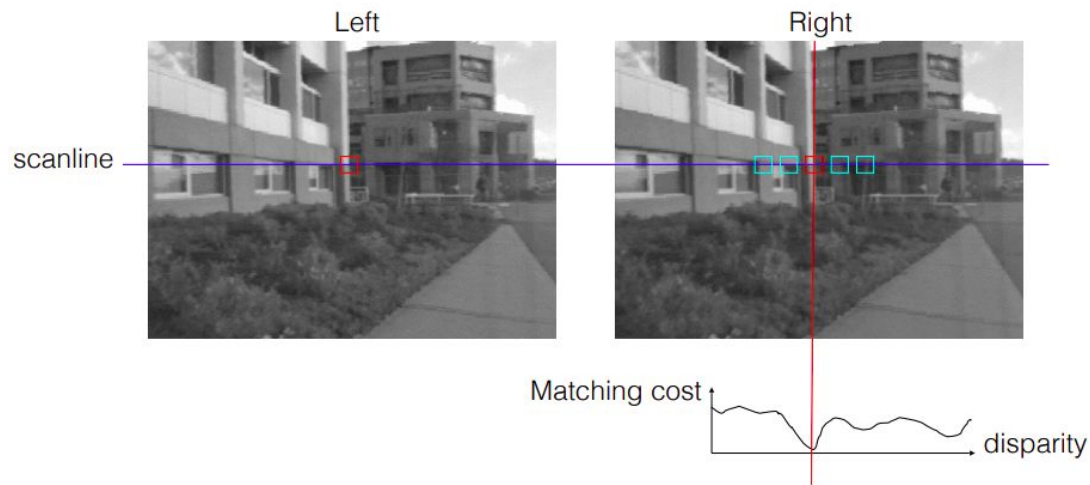
Reconstruction from two views

Estimate Camera Matrices



Depth map computation

Local methods on rectified images



Multiple cost metrics including: Sum of Squared Differences (SSD) and Normalized Cross Correlation (NCC).

Depth map computation

Local methods on rectified images

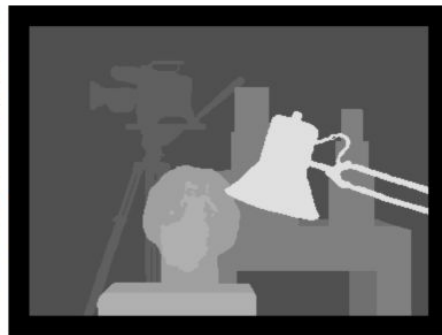
Test quantitatively with: Middlebury images



(a) Reference image.



(b) Target image.



(c) Ground-truth disparity map.

Focal length and baseline of the camera configuration is available at:
<https://vision.middlebury.edu/stereo/data/scenes2014/> you might need them (?)

Depth map computation

Local methods on rectified images

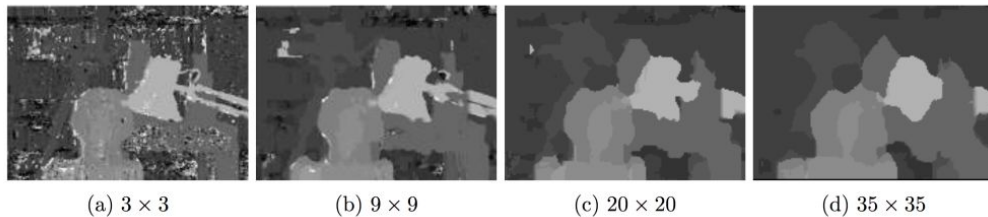
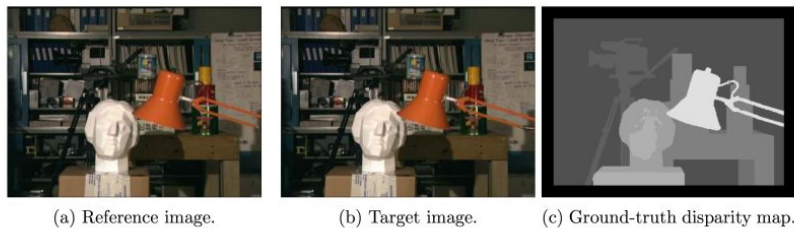
Test qualitatively on Castle facade images (rectified)



Depth map computation

Local methods on rectified images

Effect of the window size



Smaller window

+ more detail

– more noise

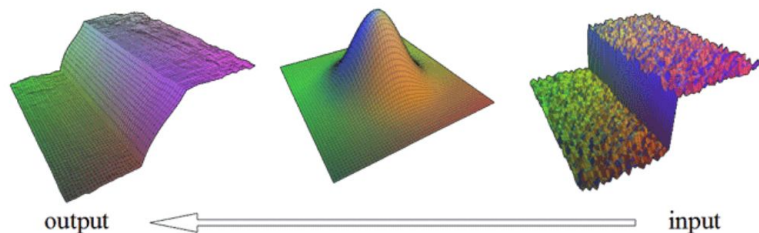
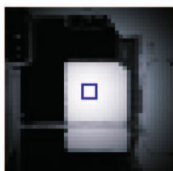
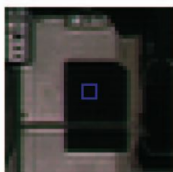
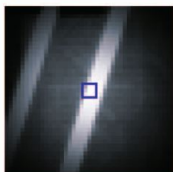
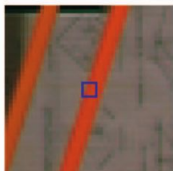
Larger window

– less detail

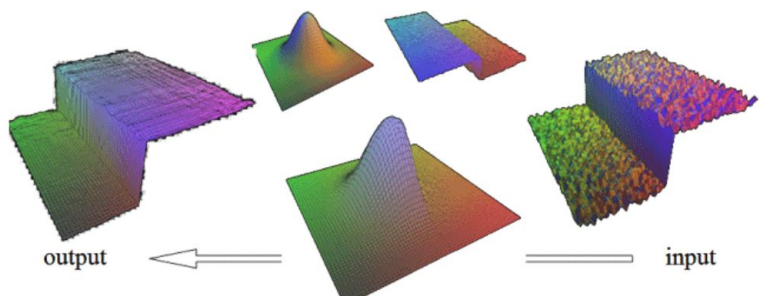
+ smoother disparity maps

Depth map computation

Local methods on rectified images **Adaptive Support Weights**



Gaussian-like



Bilateral

Optional Points

Find details on the Notebook.