

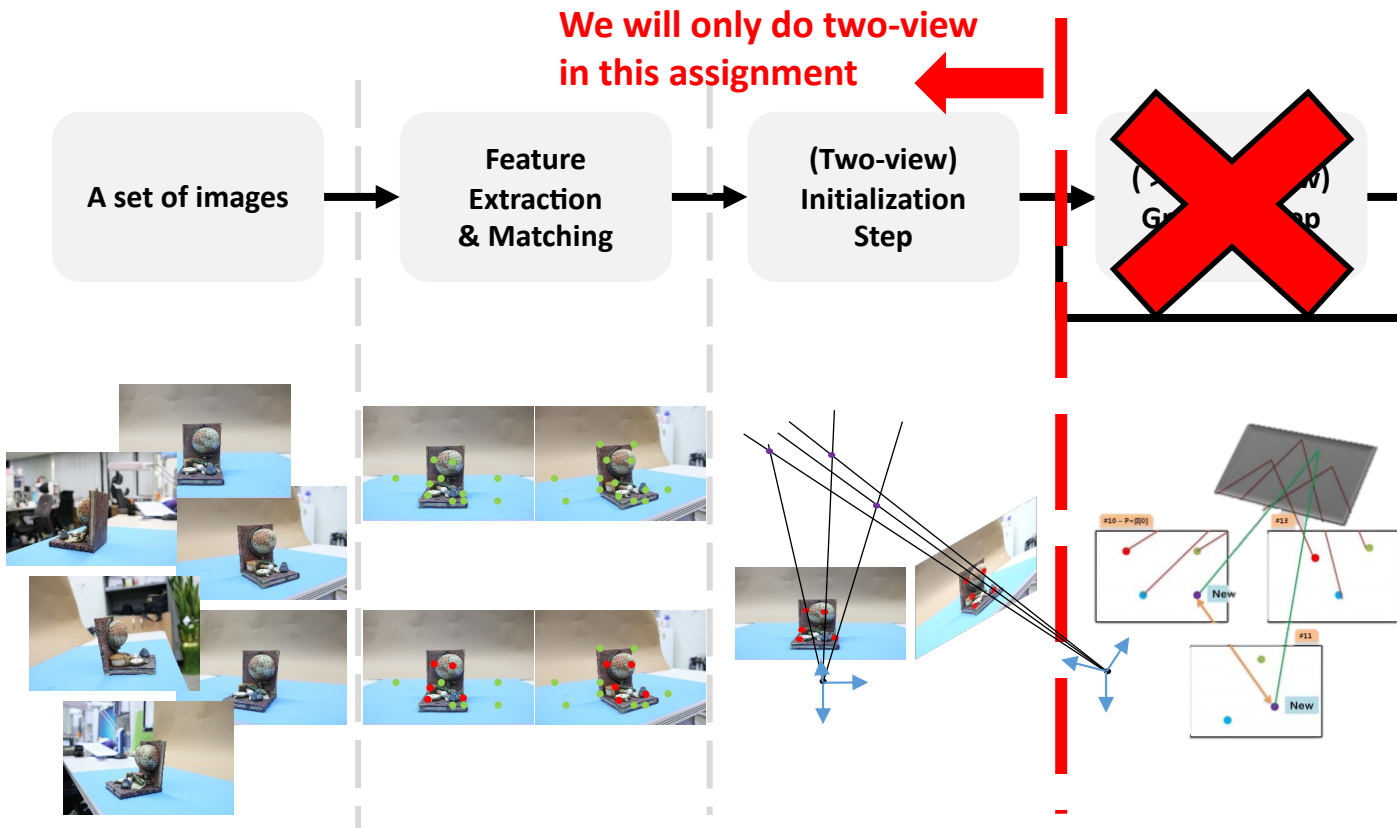
Programming Assignment3

Structure-from-Motion

Prof. Inwook Shim

To Do List

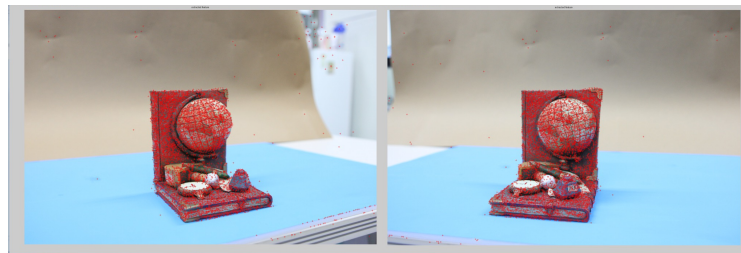
- Overall strategy



- [4] Hartley, Richard, and Andrew Zisserman. *Multiple view geometry in computer vision*. Cambridge university press, 2003.
[5] Szeliski, Richard. *Computer vision: algorithms and applications*. Springer Science & Business Media, 2010.

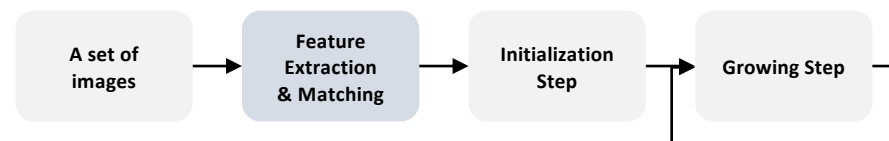
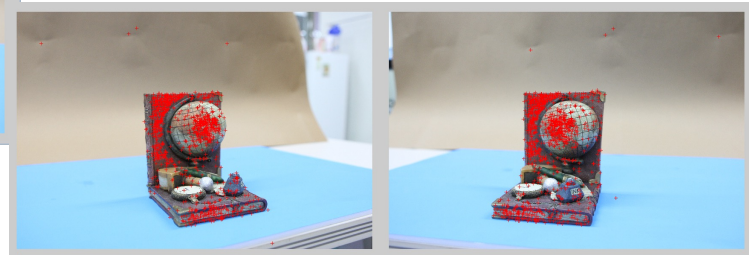
To Do List

1. Load the input images ('sfm01.jpg', 'sfm02.jpg')
2. **Extract features** from both images using the function 'vl_sift' (2 pts)
3. **Match features** (find correspondence) between two images using the function 'vl_ubcmatch' (3 pts)



Feature Extraction

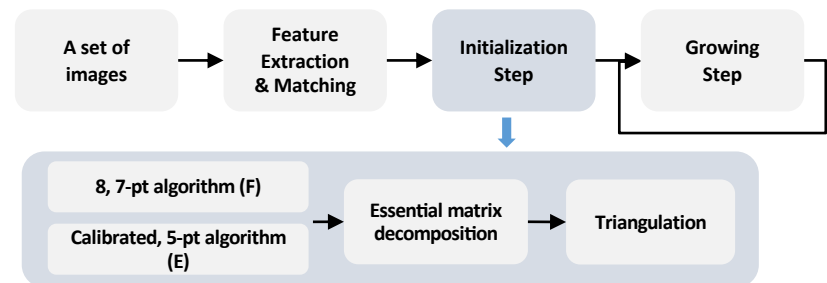
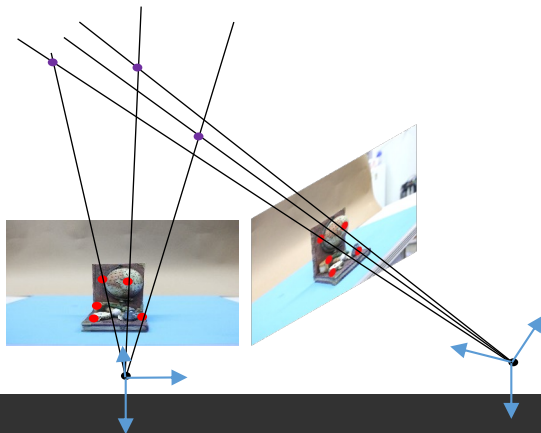
Feature Matching



Refer: <http://www.vlfeat.org/overview/sift.html>

To Do List

4. Estimate **Essential matrix \mathbf{E}** with **RANSAC** using 'calibrated_fivepoint' (5 pts)
5. Decompose essential matrix \mathbf{E} to camera extrinsic $[\mathbf{R}|\mathbf{T}]$ (5 pts)
6. Generate 3D point by implementing **Triangulation** (5 pts)
7. If you reconstruct 3D models from multiple view images (more than 3 views), I will give a huge extra credit (up to 5pts)

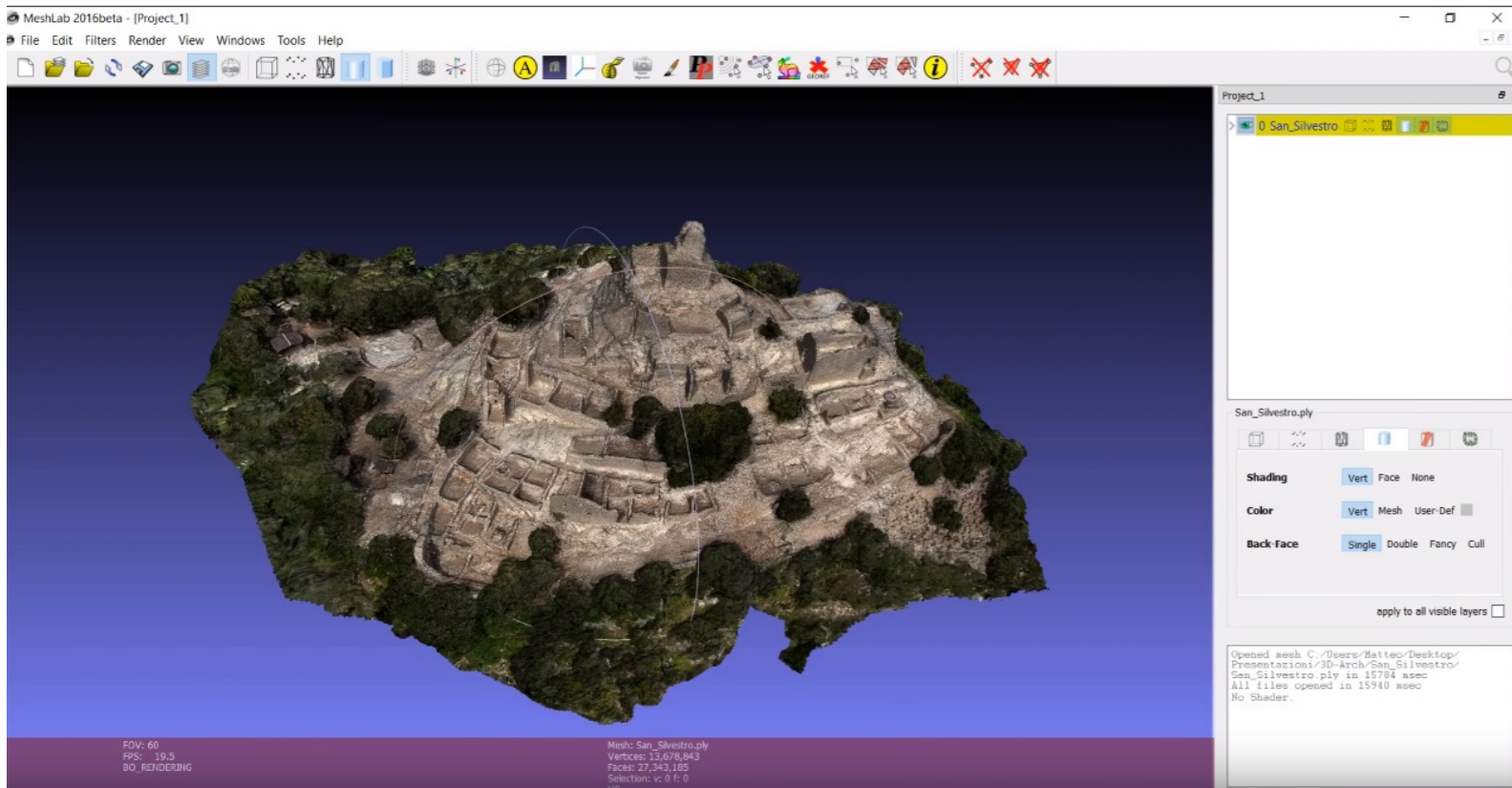


For Python Student

- **Not** allow to use OpenCV functions except below :
 - `cv2.SIFT_create` (Step I)
 - `cv2.xfeatures2d.SIFT_create` (Step I)
 - `cv2.findChessboardCorners` (Step VII)
 - `cv2.cornerSubPix` (Step VII)
 - `cv2.calibrateCamera` (Step VII)
 - `cv2.solvePnP()` (Step V)
 - Image I/O function
 - Image visualization function
 - If you think other functions are mandatory, email me

Display your 3D results (ply file)

Use Meshlab (download: <http://www.meshlab.net>)



Submission

- Submission should include...
 - Source code
 - Results (3D point cloud in **ply file**) of your code
 - Readme file explaining how to execute the program
 - **Report** (3pts)
- Report should include...
 - Your understanding of each steps of algorithms
 - Figures of results from your implementation
- Notice
 - [Delayed submission] **Not allowed**
 - [Plagiarism] Definitely **F grade** for copied codes (from friends or internet)
 - [Implementation] **No use** any open function such as findFundamentalMat() other than the mentioned function

Auxiliary References

- Multiple-View Geometry in Computer Vision
(<https://github.com/liulinbo/slam/blob/master/Multiple%20View%20Geometry%20in%20Computer%20Vision.pdf>)
 - Basic Projective Geometry (ch. 2,3)
 - Camera Models and Calibration (ch. 6,8)
 - Epipolar Geometry and Implementation (ch. 9, 11)
 - Triangulation (ch. 12)
- Computer Vision: Algorithms and Applications
(http://szeliski.org/Book/drafts/SzeliskiBook_20100903_draft.pdf)
 - Structure from Motion (ch. 7)
- Phillp Torr's Structure from Motion toolkit
 - Includes F-matrix estimation, RANSAC, Triangulation and etc.
 - <https://kr.mathworks.com/matlabcentral/fileexchange/4576-structure-and-motion-toolkit-in-matlab>