Midterm Project – Computer Vision (INS3155)

Release Date: **April 20, 2025**
Submission Deadline: **May 03, 2025**

Instructions

- This is an individual project. Collaboration is not allowed.
- You are only allowed to use **traditional image processing methods**. Do **not** use any deep learning models or pretrained networks.
- You may use OpenCV, NumPy, Matplotlib, Open3D, or other non-learning libraries.
- Submit your report as a PDF, source code (in a ZIP or GitHub link), and visualization results.
- The project will be evaluated based on completeness, correctness, clarity, and insight.

Project Title

Traditional Image Processing for Filtering, 3D Reconstruction, and Image Stitching

Objectives

You will implement and compare classical computer vision techniques for:

1) Image filtering and enhancement
2) 3D reconstruction from stereo images
3) Image stitching from multiple views

Part A – Image Filtering

Apply and compare different traditional filters to remove noise and enhance images:

- Mean filter
- Gaussian filter
- Median filter
- Laplacian sharpening

Deliverables:

- Original, noisy, and filtered images (side-by-side)
- Comparison of filters on noise reduction and edge preservation

Part B – 3D Reconstruction

Using stereo images:

- Compute disparity map using block matching or SGBM.
- Reconstruct the 3D point cloud from the disparity.
- Estimate the fundamental matrix and draw epipolar lines.

Deliverables:

- Disparity map and point cloud visualization
- Epipolar lines on the input images
- Brief explanation of your stereo algorithm

Part C – Image Stitching

Implement an image stitching pipeline using the following steps:

- Detect features using SIFT, SURF, or ORB.
- Match features between four overlapping images.
- Estimate the homography matrix using RANSAC.
- Warp images and blend them into a panorama.

Deliverables:

- Matched keypoints visualization
- Final panorama image
- Short explanation of homography estimation

Comparative Analysis (Required)

For each part (A–C), compare at least two alternative methods or parameter settings. Discuss:

- Strengths and weaknesses
- Quantitative evaluation (e.g., PSNR, number of inliers)
- Qualitative visual inspection

Final Report Guidelines

Submit a clearly written PDF report including:

- Introduction and motivation
- Description of methods with equations/diagrams
- Implementation steps and results
- Comparison and analysis
- Conclusion and possible extensions

Grading Rubric (100 Points)

Component	**Points**
Image Filtering (Part A)	20
3D Reconstruction (Part B)	25
Image Stitching (Part C)	25
Comparative Analysis	15
Report Quality	10
Code Quality and Results	5

Note: Bonus points may be awarded for use of your own images, insightful visualizations, or additional comparative experiments.