3-D PANORAMA

CAI JIANXIONG

ZENG XIANGCHEN

GAO LING

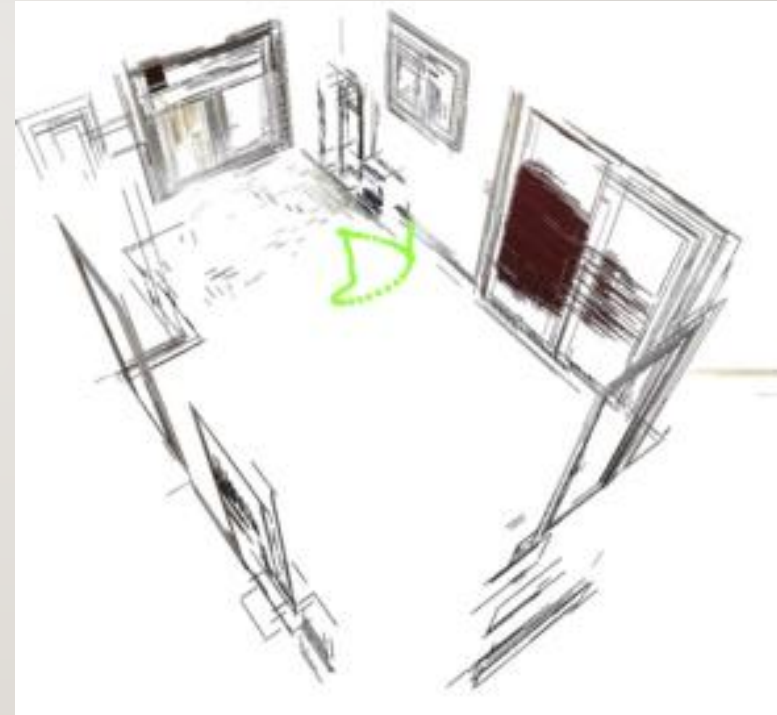# INTRODUCTION

What's our goal?

Source: MATLAB "Feature Based Panoramic Image Stitching" with our data

2D PANORAMA

3D PANORAMA

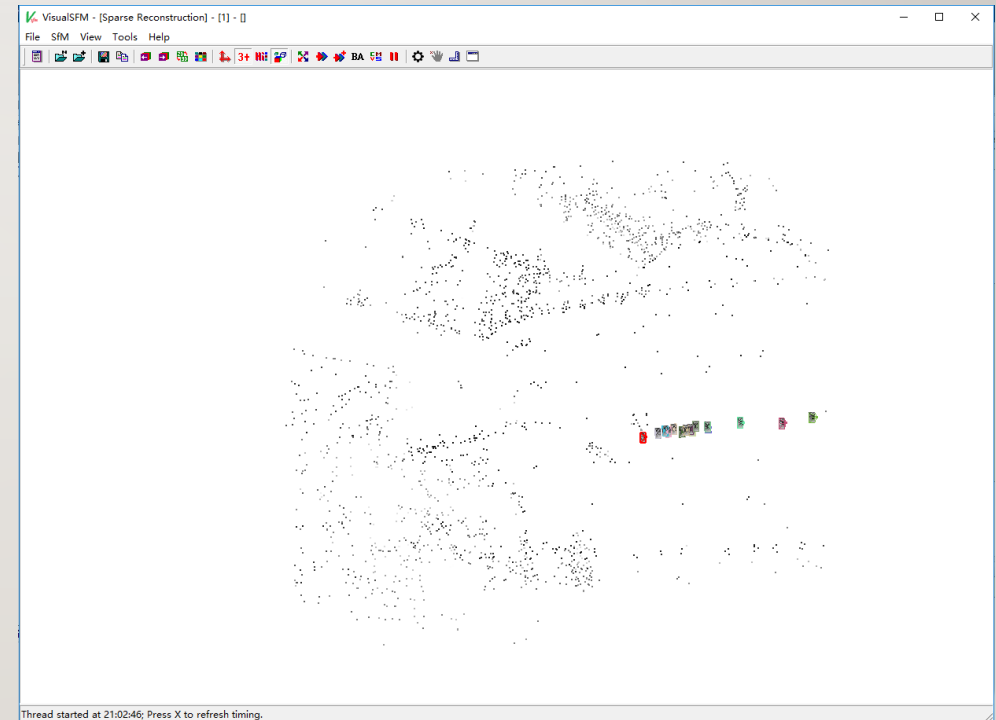MATLAB "Structure From Motion From Multiple Views" with our data

Source: Panoramic Structure from Motion via Geometric Relationship Detection
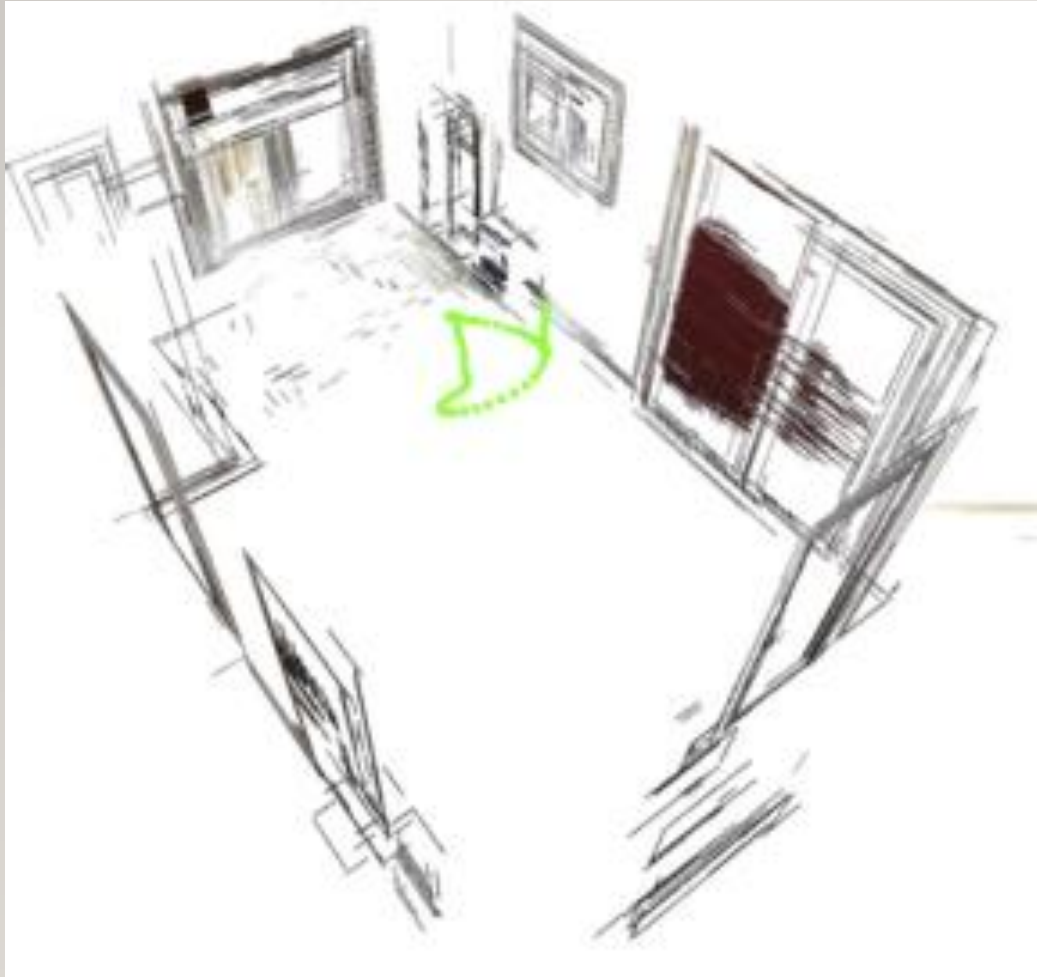
RELATED WORK

Points based SFM

- MATLAB Structure From Motion From Multiple Views (similar to HW3)

- VisualSFM : A Visual Structure from Motion System

- 1-point RANSAC
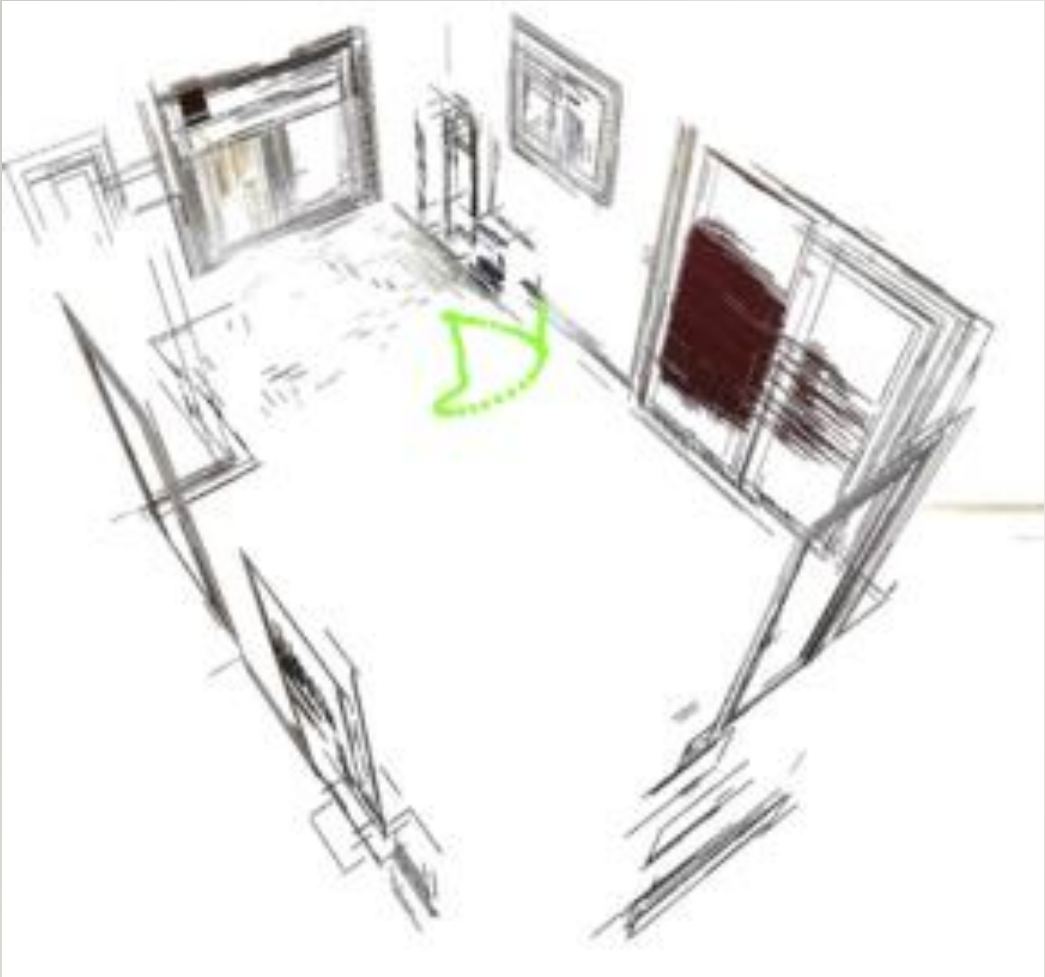

Source: VisualSFM with our data

LINE BASED SFM

Paper "Panoramic Structure from Motion via Geometric Relationship Detection"

Pipeline:

1. Line segment detection

2. Manhattan frame & line extraction

3. Line tracking

4. Geometric relationship detection

5. Linear SfM

6. Bundle adjustment

Ikehata, S., Boyadzhiev, I., Shan, Q., & Furukawa, Y. (2016). Panoramic Structure from Motion via Geometric Relationship Detection. Retrieved from http://arxiv.org/abs/1612.01256
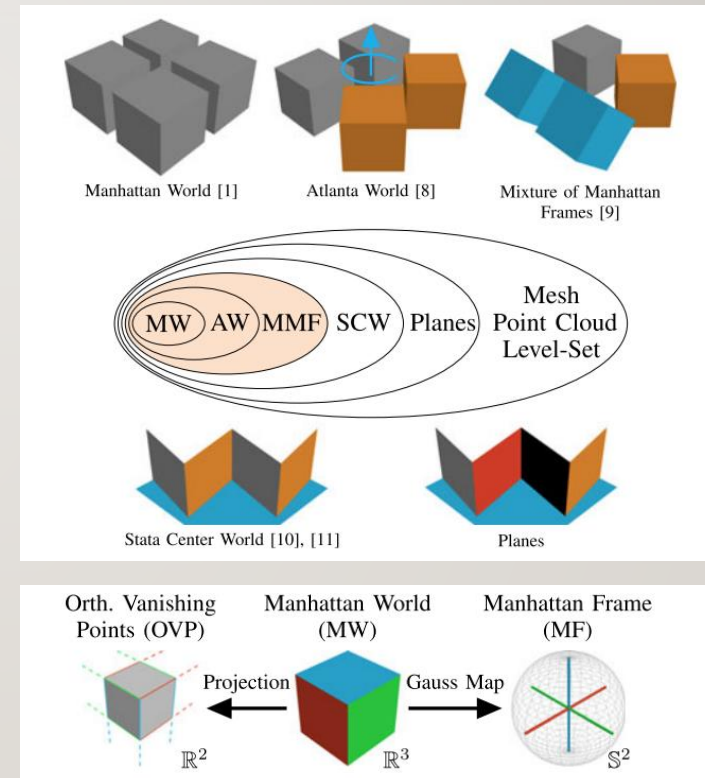
LINE BASED SFM

Pipeline:

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MANHATTAN FRAME

- The edges of man-made objects can all follow some particular directions.

- For many indoor environments, the objects in it can be classified into "Manhattan world" objects.

Straub, Julian, et al. "The manhattan frame model—manhattan world inference in the space of surface normals." *IEEE transactions on pattern analysis and machine intelligence* 40.1 (2018): 235-249.

MANHATTAN WORLD LINE EXTRACTION

CAST VOTES ON GAUSSIAN SPHERE

- Generate a **Gaussian Sphere**.
- Lines → **interpretation plane**.
- Cast votes to the Gaussian Sphere.
- Extract **Manhattan frame** (total 3 directions).
- Extract **Manhattan lines**.
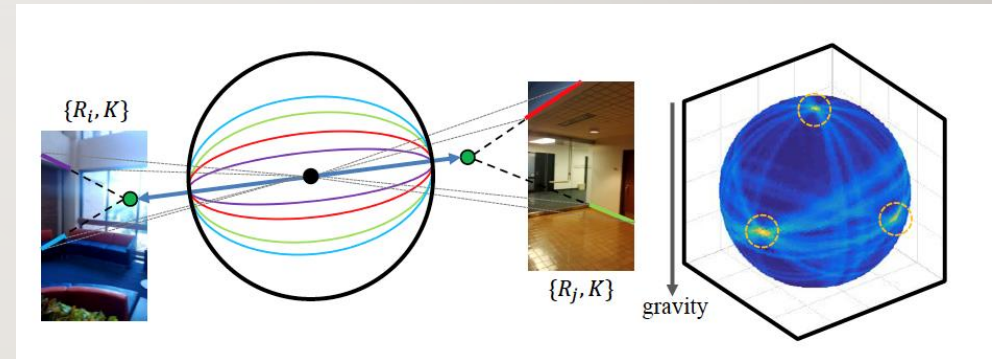
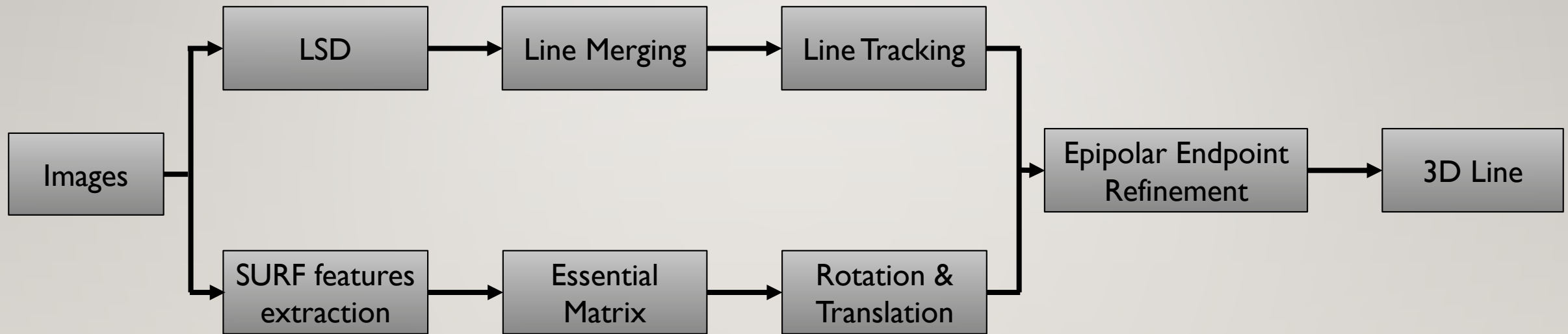# MANHATTAN WORLD LINE EXTRACTION

Problem with that approach

- Manhattan world assumption – Strong Assumption

- Deep-network for surface normal estimation
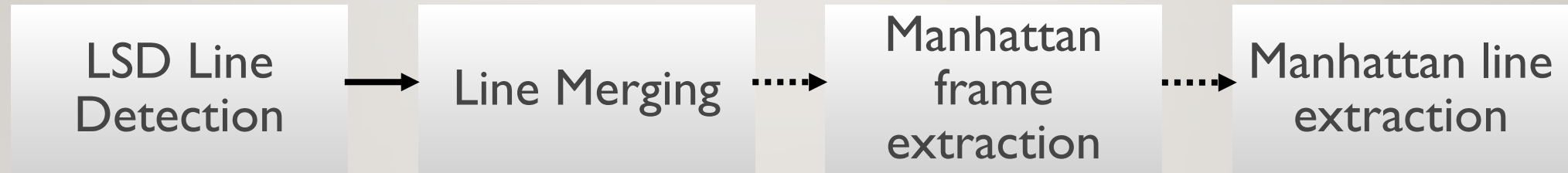
TECHNICAL APPROACH

Technical Approach

Data Pre-processing

following "Panoramic Structure from Motion via Geometric Relationship Detection"

LSD Line Detection → Line Merging ⇢ Manhattan frame extraction ⇢ Manhattan line extraction

LSD LINE DETECTION

An OpenSource Library for line extraction

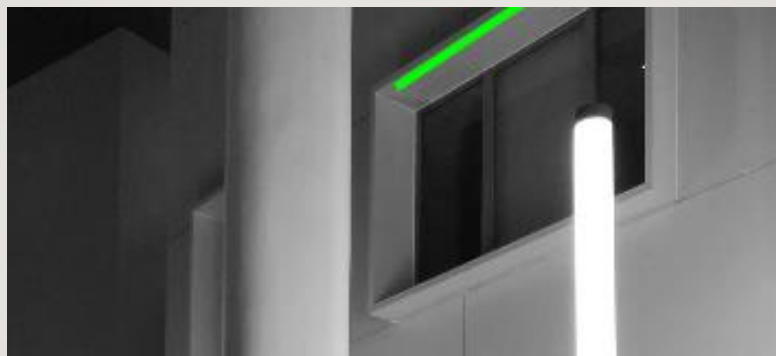Grompone von Gioi, R., Jakubowicz, J., Morel, J.-M., & Randall, G. (2012). LSD: a Line Segment Detector. *Image Processing On Line*, 2, 35–55. https://doi.org/10.5201/ipol.2012.gjmr-lsd

LINE MERGING

We Implemented the paper:

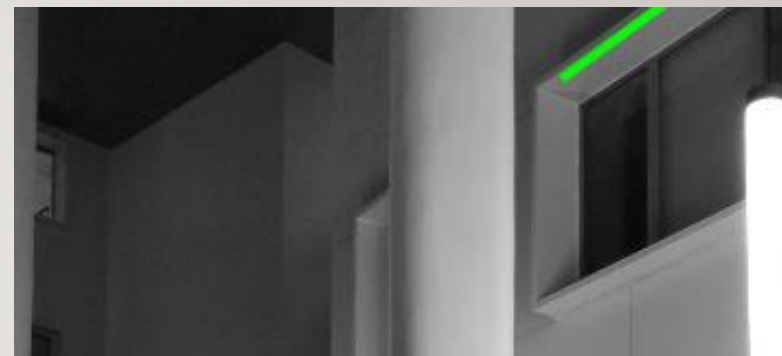Tavares, J. (1995). A new approach for merging edge line segments. *RecPad95*, (January). Retrieved from http://repositorio-aberto.up.pt/handle/10216/420
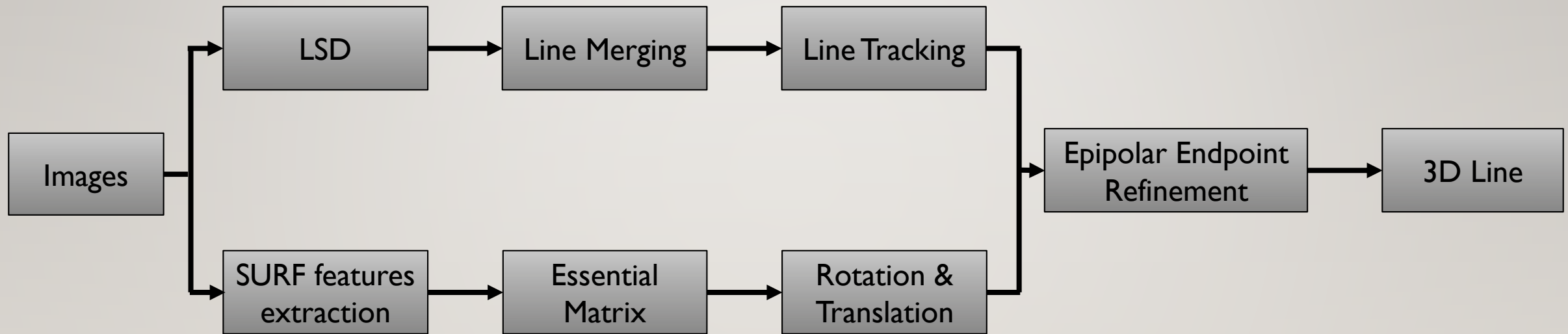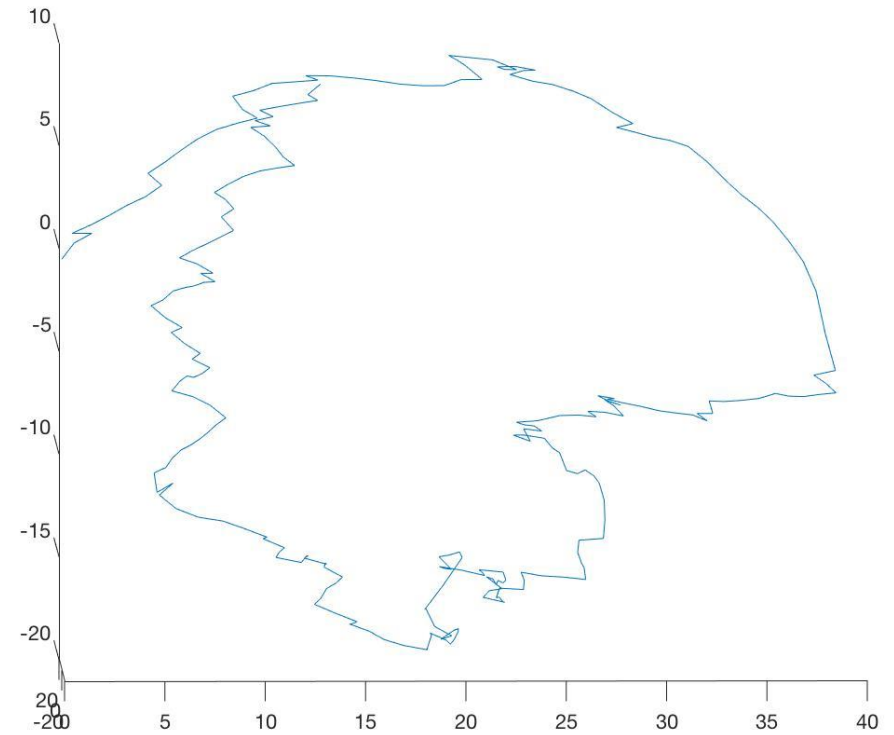
Frame 1

Frame 7

Frame 14

LINE TRACKING

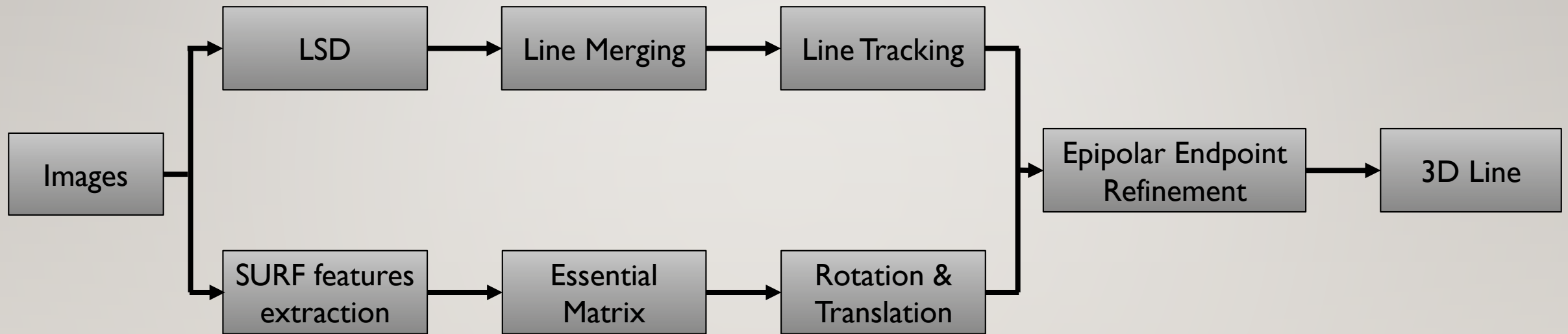We implemented "Panoramic Structure from Motion via Geometric Relationship Detection" Line Tracking Section
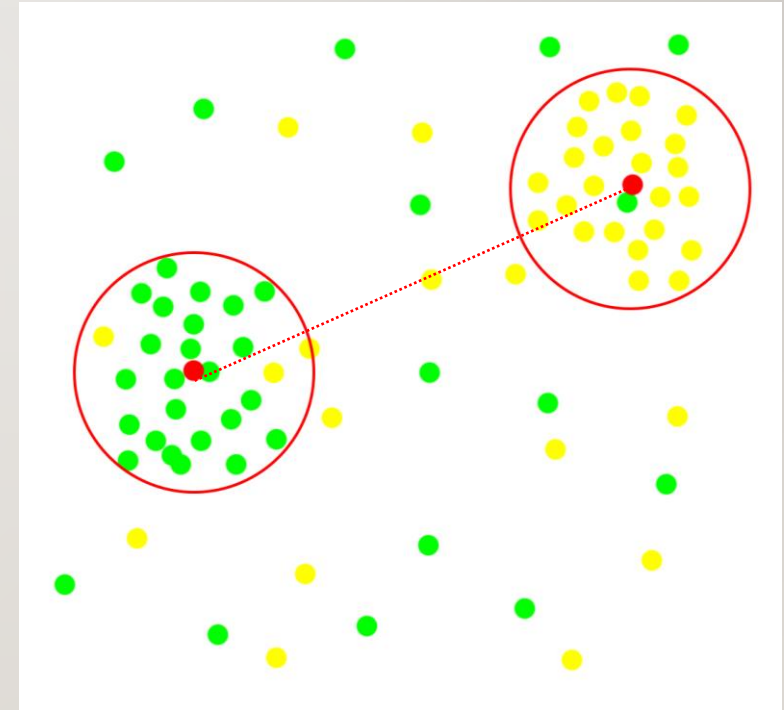
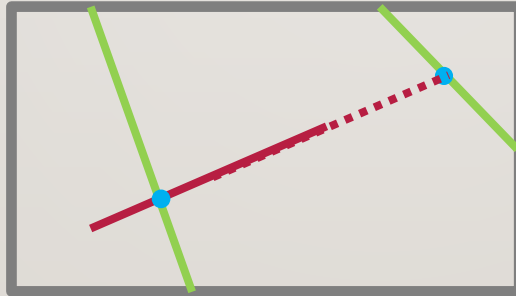# Technical Approach

Trajectory

Technical Approach

SOME REFINEMENTS ON REPROJECTION

EPIPOLAR LINES

3D POINT RANSAC

RESULT

View the result in MATLAB (Line_Cloud.fig in presentation folder)

WHY IT LOOKS SO TERRIBLE?

- The Inaccuracy of the lines.

- Occlusion

- Reflection on the ground

- The Complexity of Environments.

REFERENCE

- Ikehata, S., Boyadzhiev, I., Shan, Q., & Furukawa, Y. (2016). Panoramic Structure from Motion via Geometric Relationship Detection. Retrieved from http://arxiv.org/abs/1612.01256

- Tavares, J. (1995). A new approach for merging edge line segments. *RecPad95*, (January). Retrieved from http://repositorio-aberto.up.pt/handle/10216/420

- Grompone von Gioi, R., Jakubowicz, J., Morel, J.-M., & Randall, G. (2012). LSD: a Line Segment Detector. *Image Processing On Line*, 2, 35–55. https://doi.org/10.5201/ipol.2012.gjmr-lsd

- Coughlan, J. M. (1999). Manhattan World : Compass Direction from a Single Image by Bayesian Inference 2 Previous Work and Three- Dimensional Geometry. *Camera*, *0*(c).

- VisualSFM : A Visual Structure from Motion System. Available at http://ccwu.me/vsfm/

Q&A

CAI JIANXIONG
caijx@shanghaitech.edu.cn

ZENG XIANGCHEN
zhengxc@shanghaitech.edu.cn

GAO LING
gaoling1@shanghaitech.edu.cn