

CAI JIANXIONG  
ZENG XIANGCHEN  
GAO LING

---

# 3-D PANORAMA

---

# INTRODUCTION

---

What's our goal?



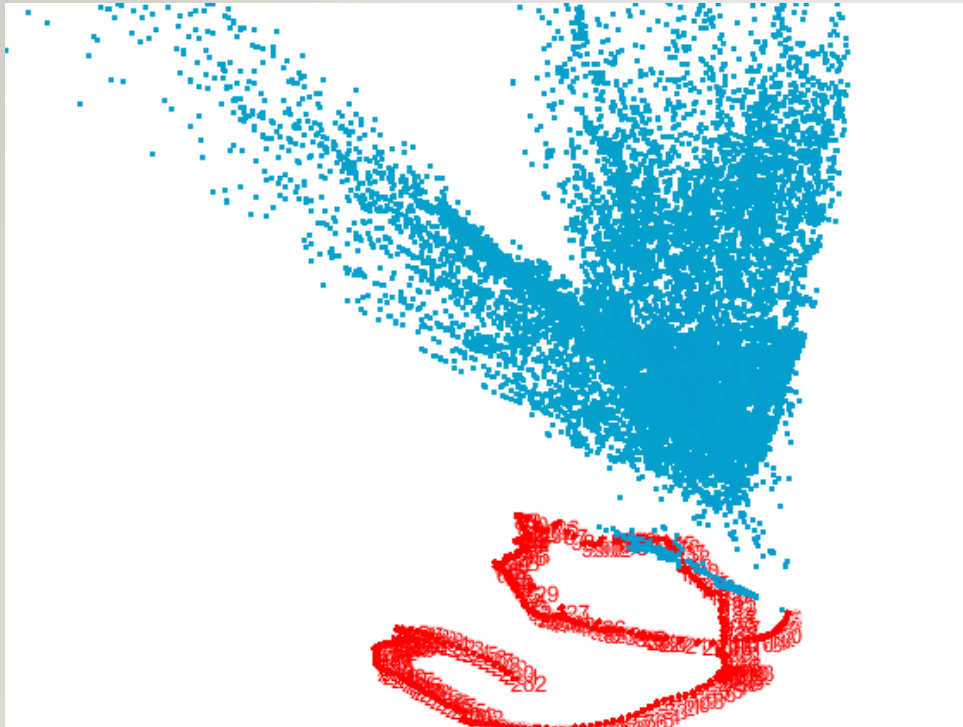
Source: MATLAB “Feature Based Panoramic Image Stitching” with our data

---

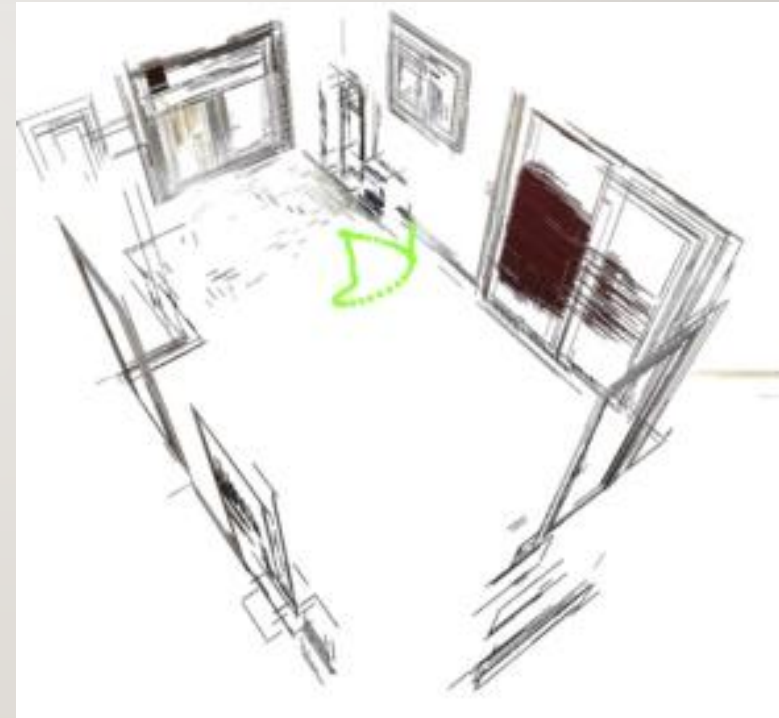
## 2D PANORAMA

# 3D PANORAMA

---



MATLAB “Structure From Motion From Multiple Views”  
with our data



Source: Panoramic Structure from Motion via Geometric  
Relationship Detection

# RELATED WORK

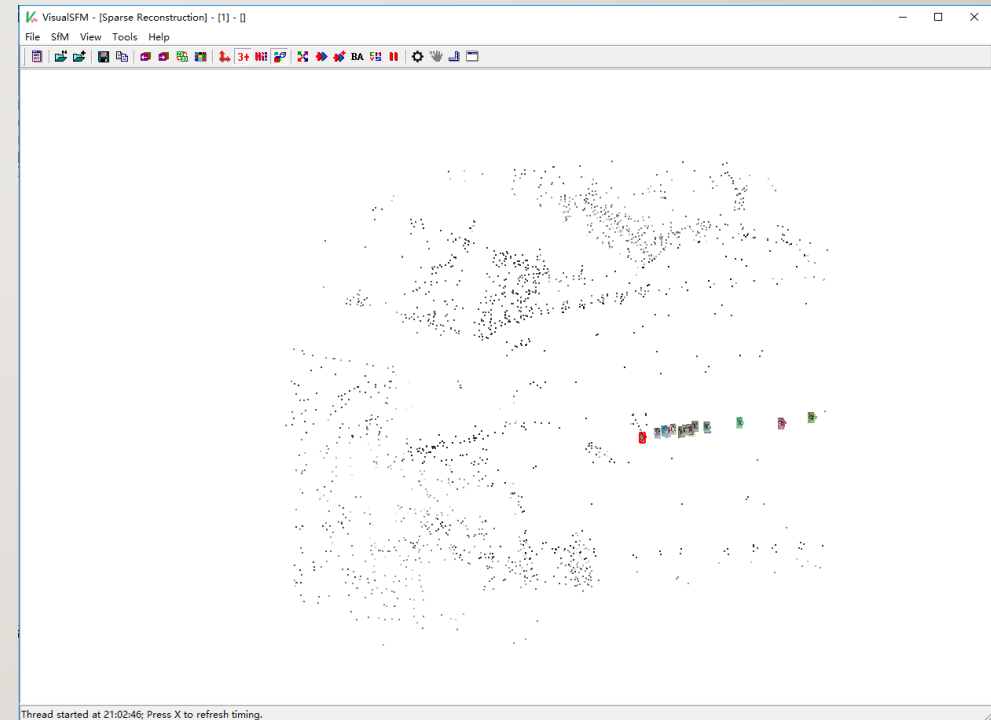
---



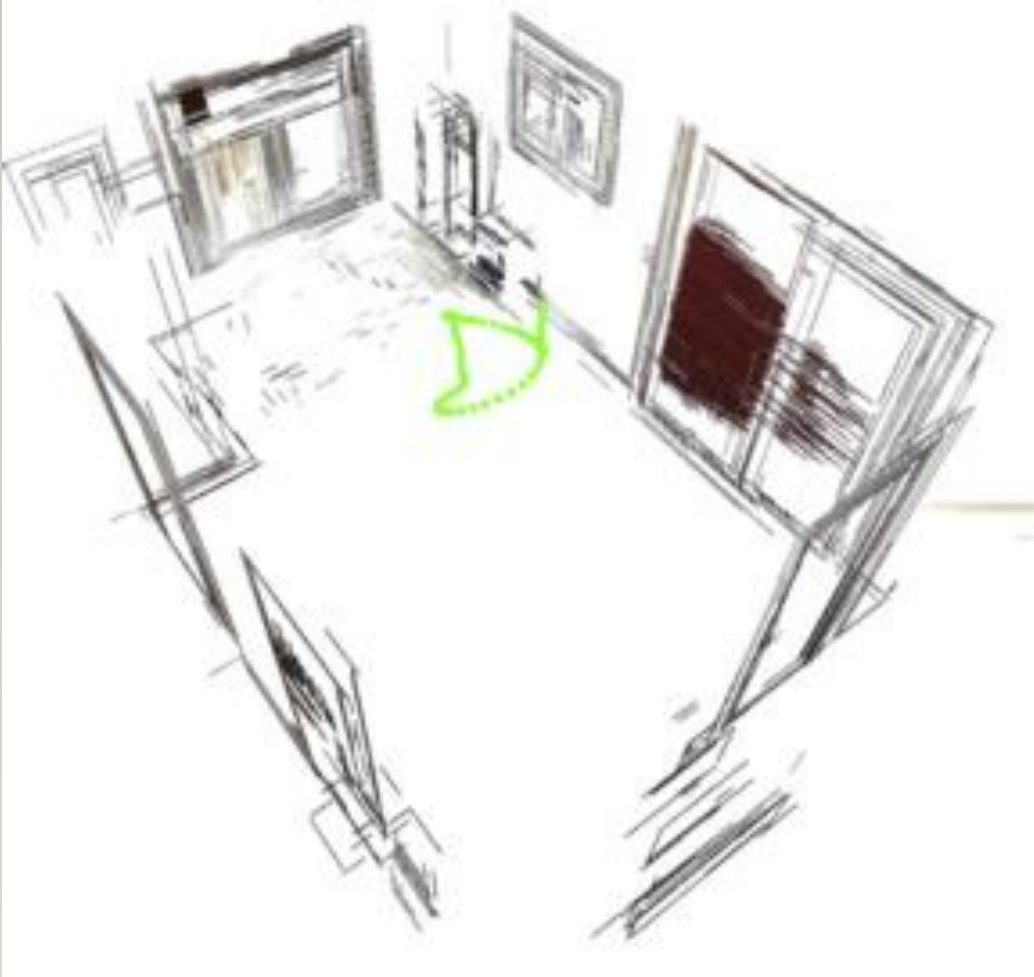


# Points based SFM

- MATLAB Structure From Motion From Multiple Views (similar to HW3)
- VisualSFM :A Visual Structure from Motion System
- I-point RANSAC



Source: VisualSFM with our data



# LINE BASED SFM

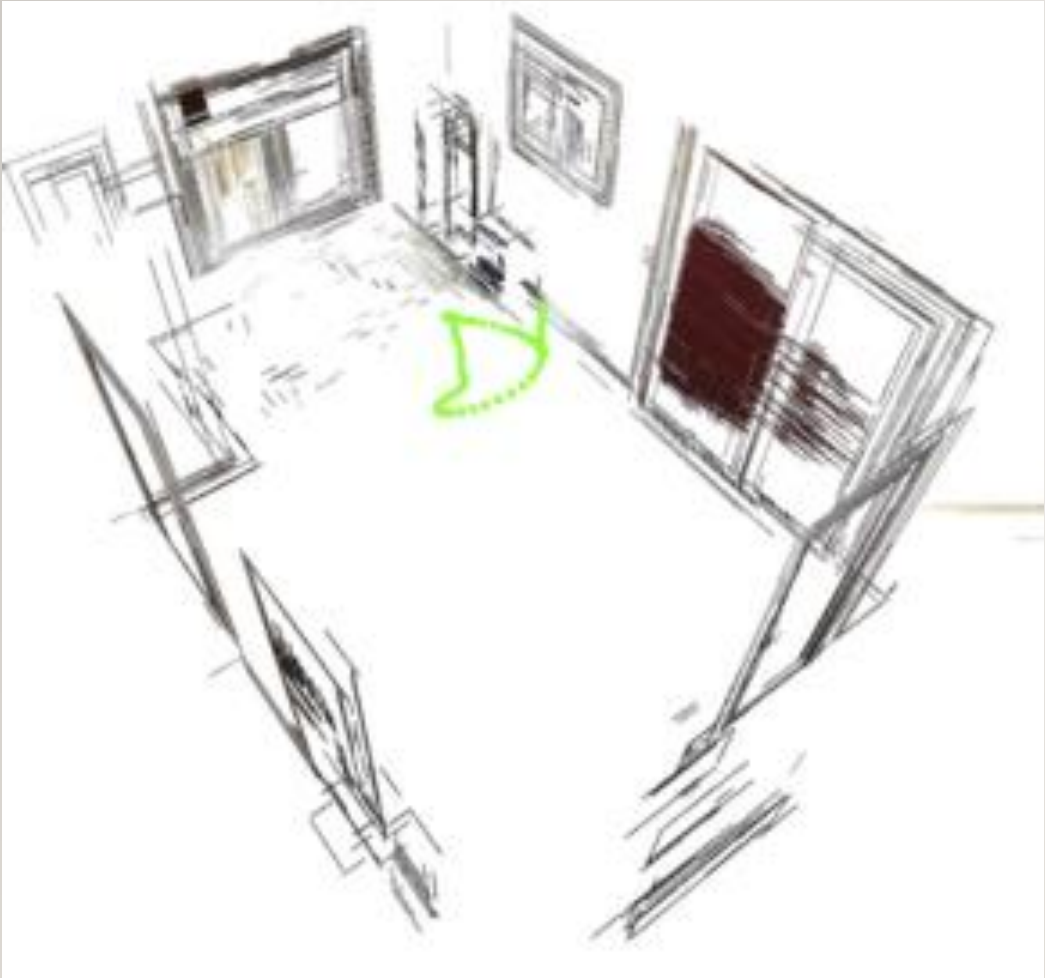
Paper “Panoramic Structure from Motion via Geometric Relationship Detection”

---

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

---

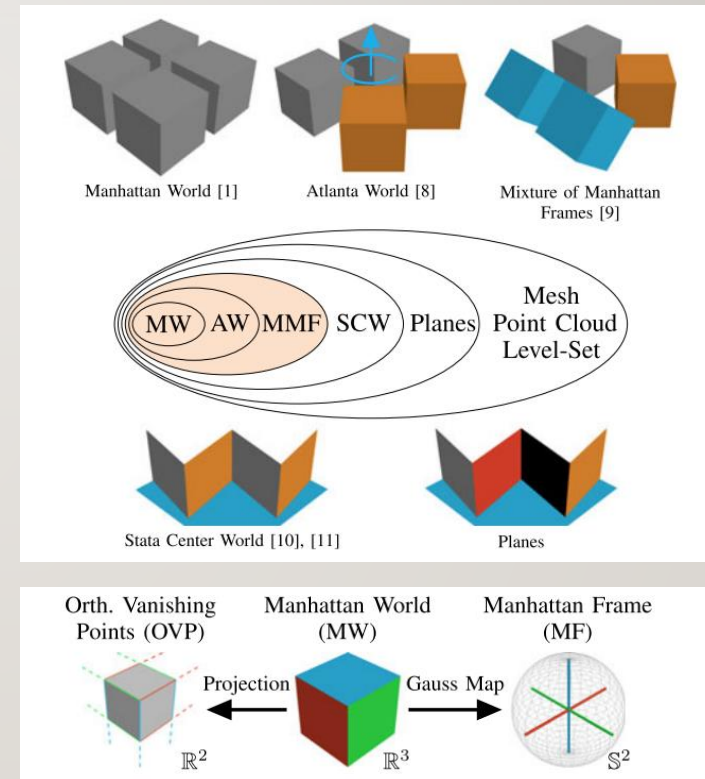
Pipeline:

1. Line segment detection
2. Manhattan frame & line extraction
3. Line tracking
4. Geometric relationship detection
5. Linear SfM
6. Bundle adjustment



# MANHATTAN FRAME

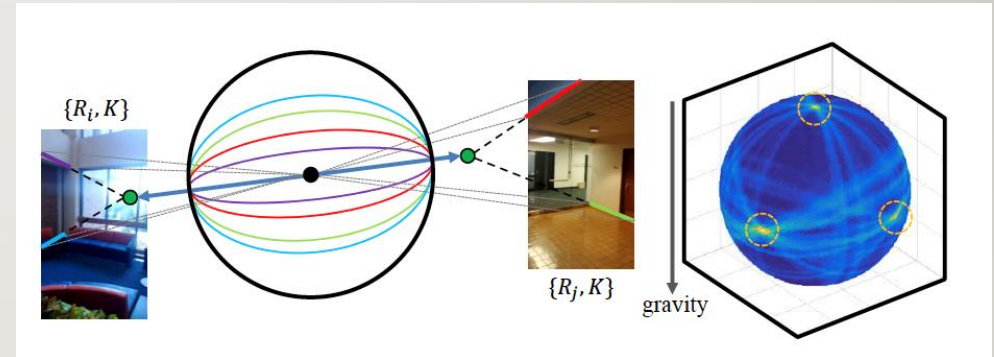
- The edges of man-made objects can all follow some particular directions.
- For many indoor environments, the objects in it can be classified into “Manhattan world” objects.



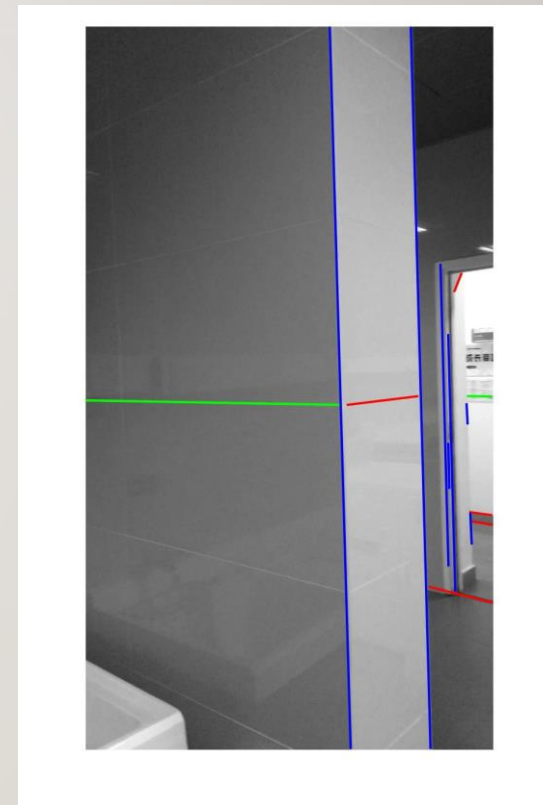
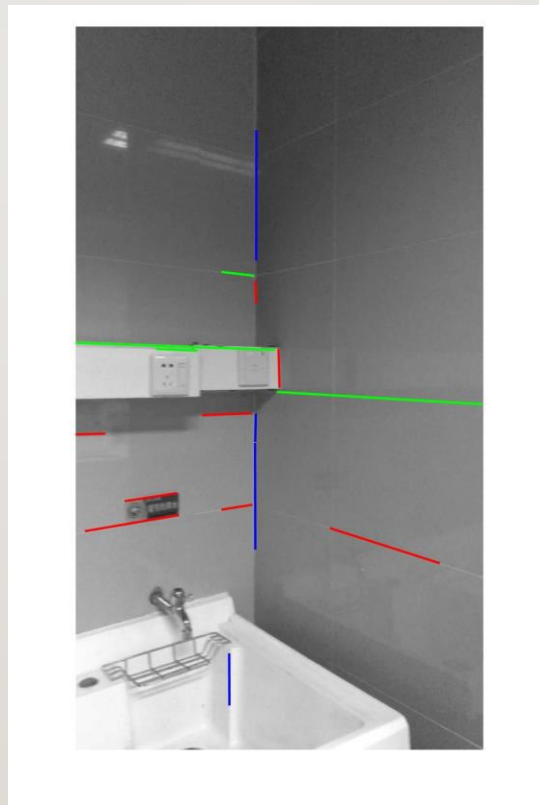
# MANHATTAN WORLD LINE EXTRACTION

## CAST VOTES ON GAUSSIAN SPHERE

- Generate a **Gaussian Sphere**.
- Lines  $\rightarrow$  **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



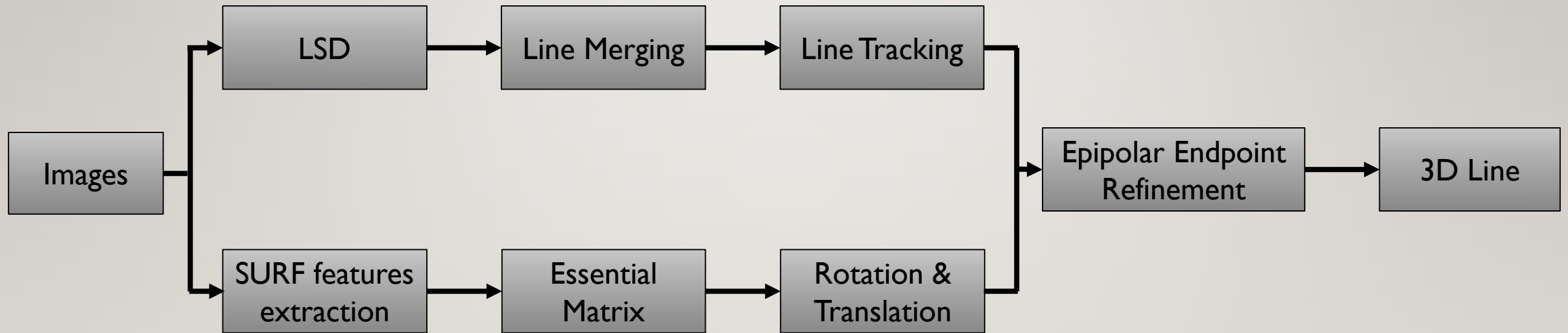
# TECHNICAL APPROACH

---



# Technical Approach

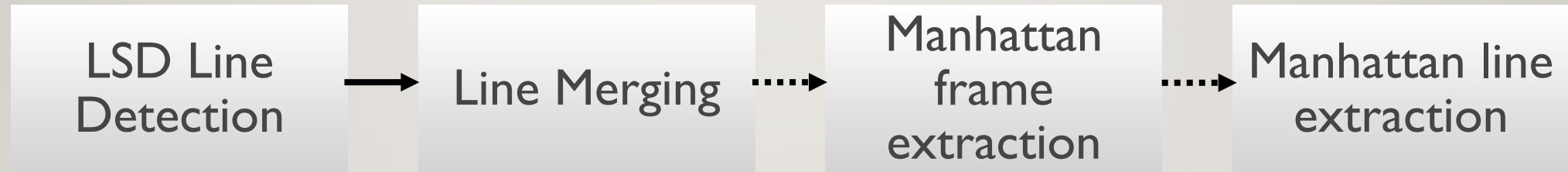
---



# Data Pre-processing

following “Panoramic Structure from Motion via Geometric Relationship Detection”

---



# LSD LINE DETECTION

---

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>



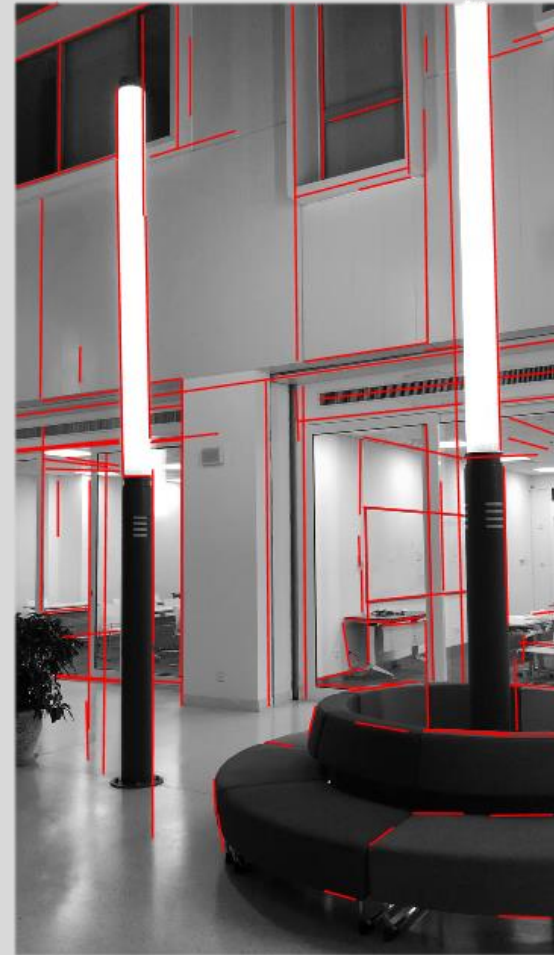


# LINE MERGING

---

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>

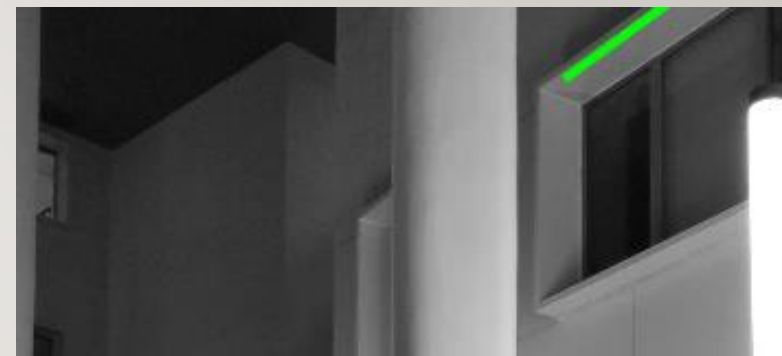




Frame 1



Frame 7



Frame 14

# LINE TRACKING

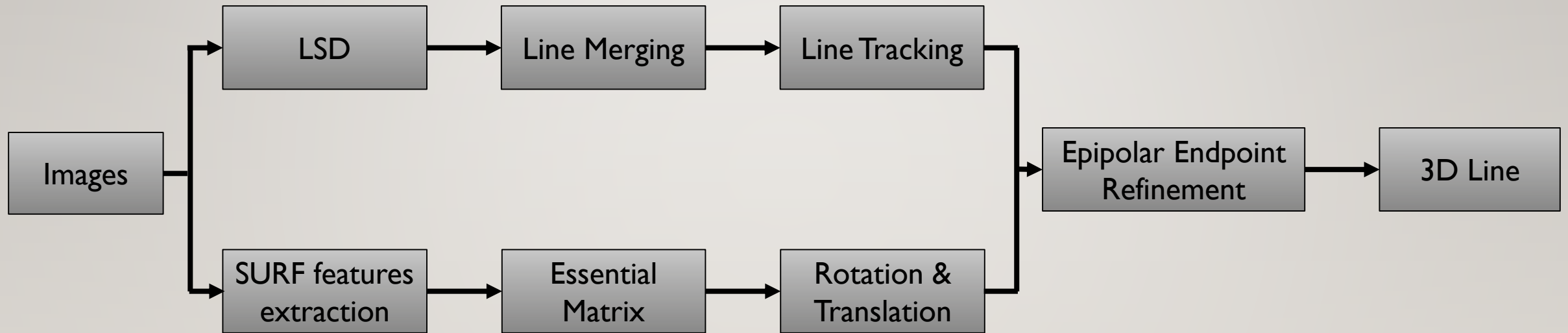
---

We implemented “Panoramic Structure from Motion via Geometric Relationship Detection” Line Tracking Section

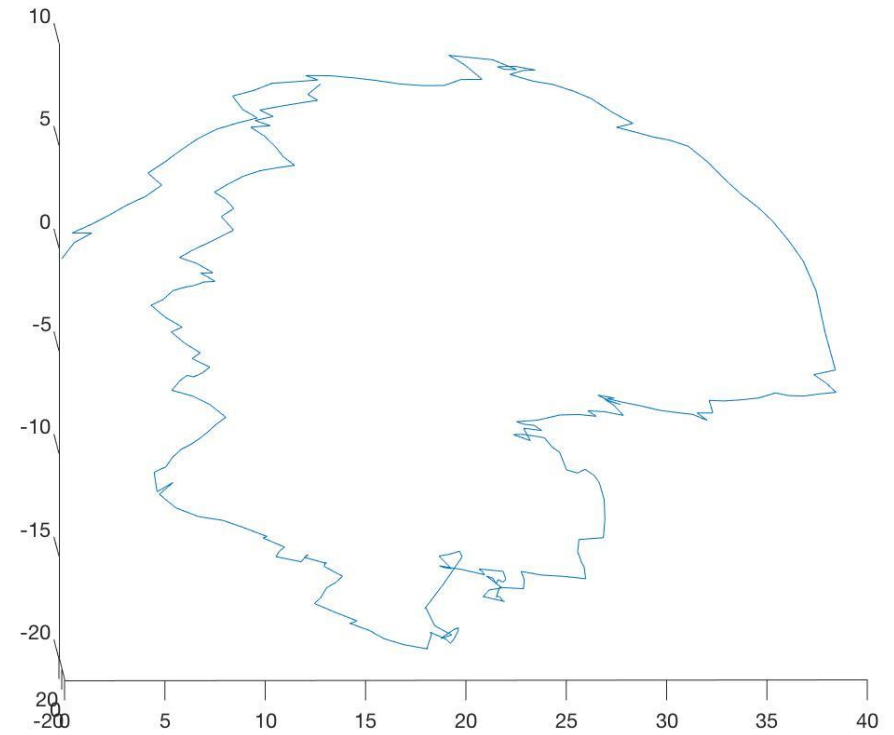


# Technical Approach

---



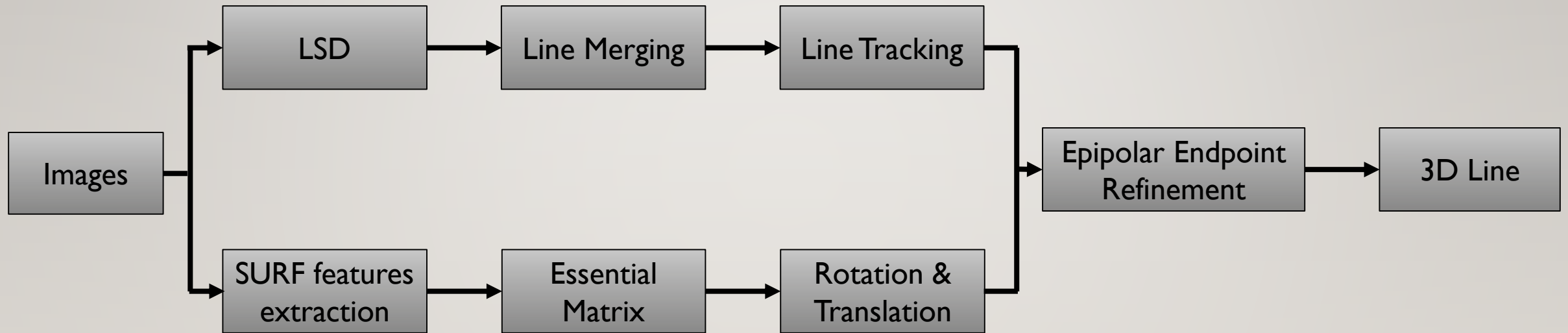
# Trajectory





# Technical Approach

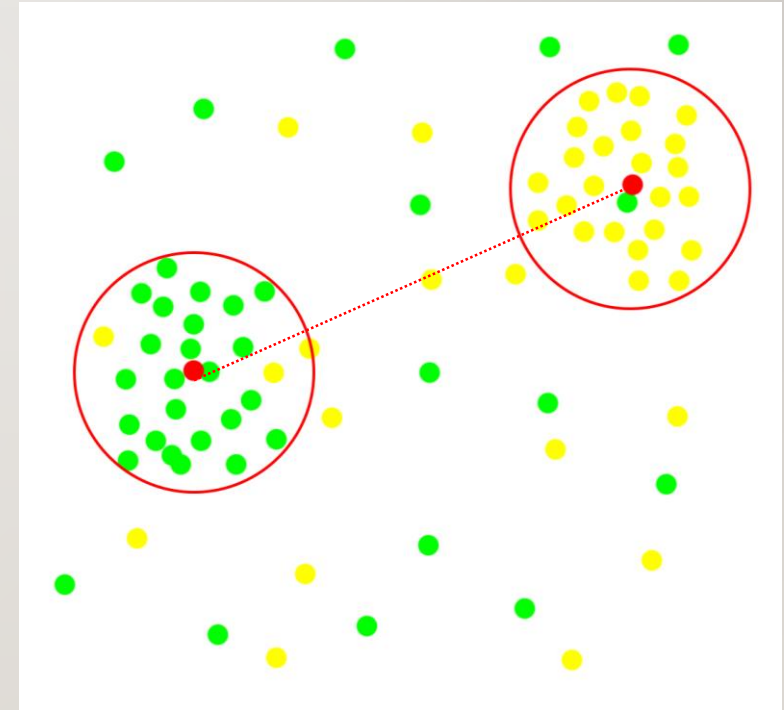
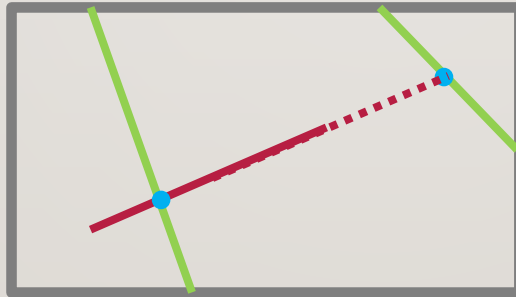
---



# SOME REFINEMENTS ON REPROJECTION

EPIPOLAR LINES

3D POINT RANSAC



# RESULT

---



# 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](mailto:caijx@shanghaitech.edu.cn)

ZENG XIANGCHEN

[zengxc@shanghaitech.edu.cn](mailto:zengxc@shanghaitech.edu.cn)

GAO LING

[gaoling@shanghaitech.edu.cn](mailto:gaoling@shanghaitech.edu.cn)