

Layout Aware Visual Tracking and Mapping

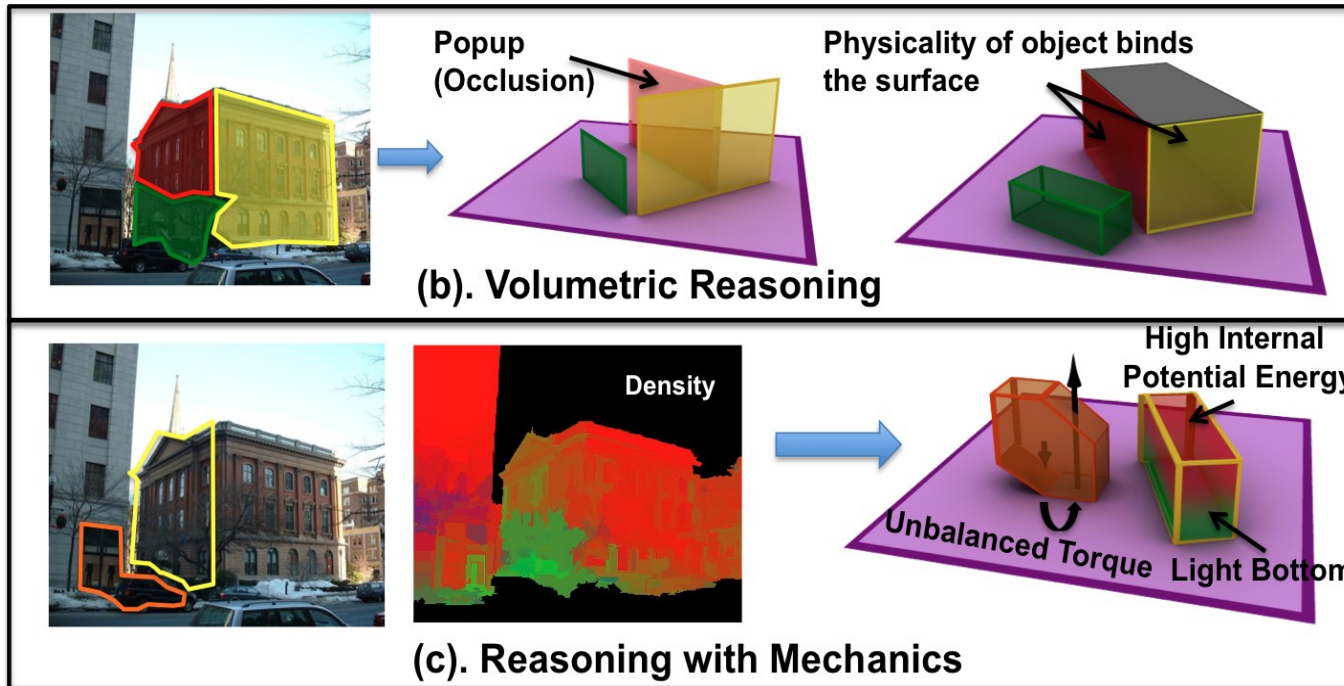
Marta Salas* , Wajahat Hussain* , Alejo Concha,
Luis Montano, Javier Civera, J. M. M. Montiel

Robotics, Perception and Real Time Group
Aragón Institute of Engineering Research (I3A)
Universidad de Zaragoza

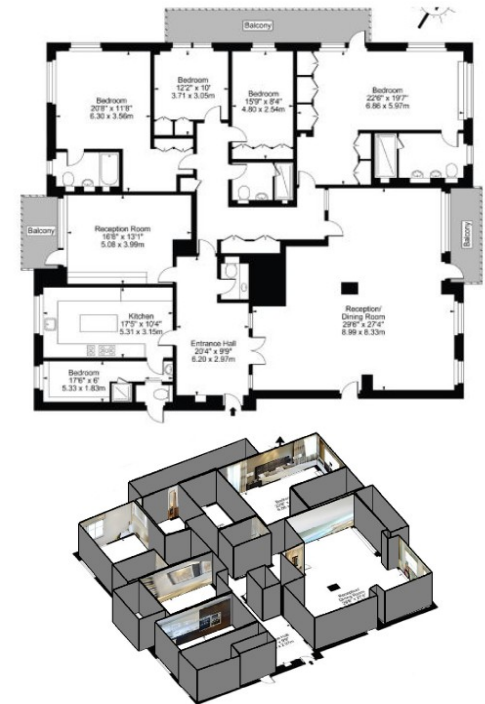


Universidad
Zaragoza

Man-made World → Structured



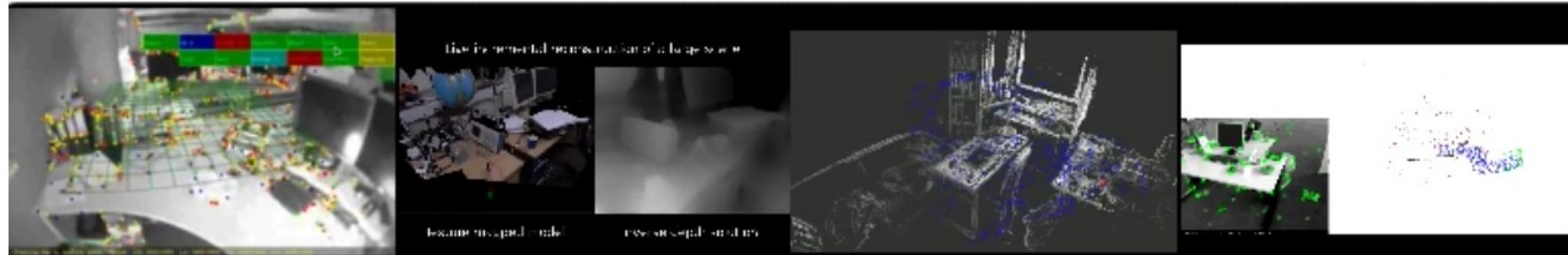
Gupta et al. CVPR '10



Liu et al. CVPR '15

Scene Understanding = Qualitative Geometric Properties

Multi-view Geometry



PTAMM
Castle et al.
2008

DTAM
Newcombe et al.
2011

LSD-SLAM
Engel et al.
2014

ORB-SLAM
Mur et al.
2014

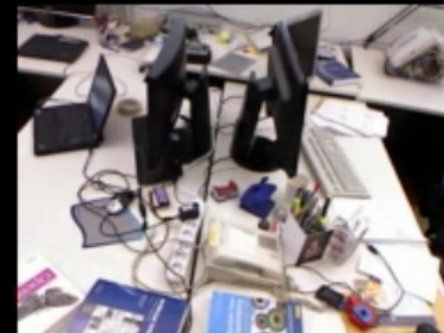
DataSets



Rawseeds



NYU-D V2



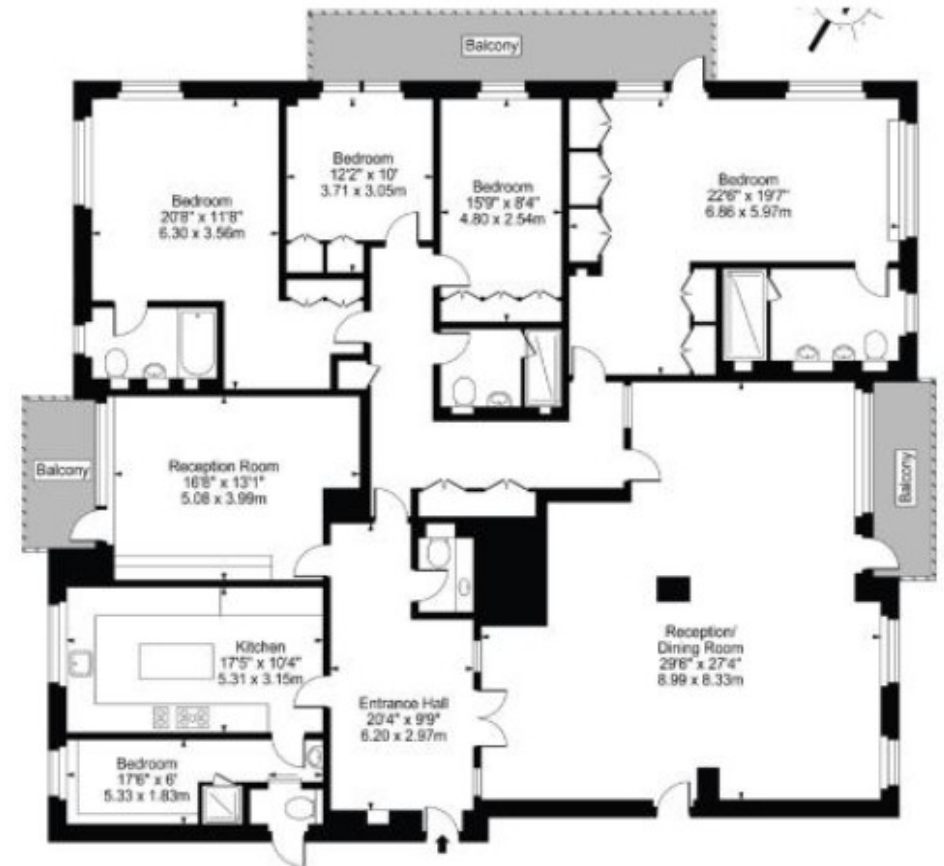
RGBD-SLAM TUM

Man-made World \neq Smooth

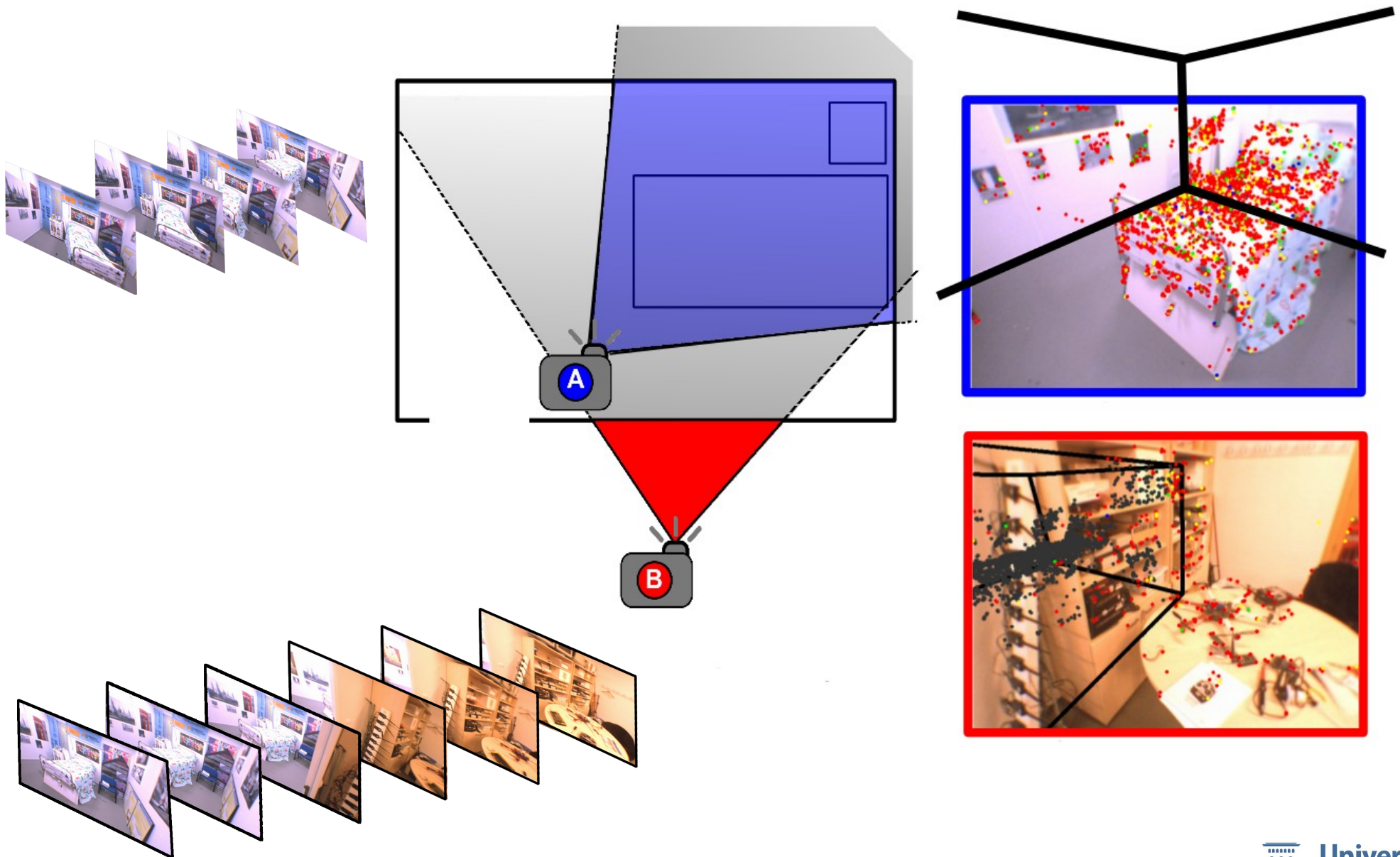
Man-made World \neq Smooth

Abrupt Transitions

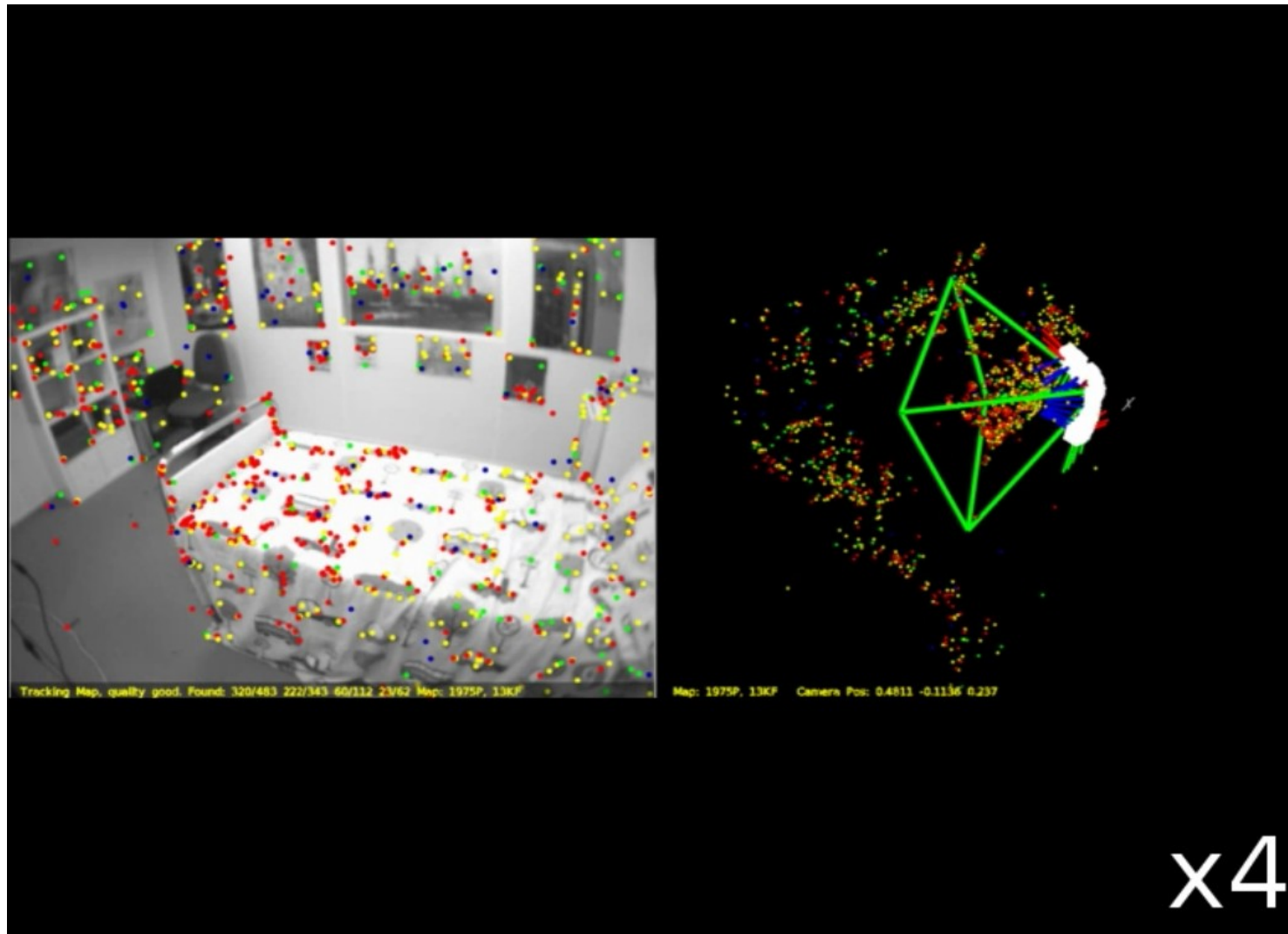
- Turning **around corner**
- Moving from **room to corridor**
- Moving from **room to room**
- Going down **stairs**
- Moving from **floor to floor**
- **Entering** and **exiting** building
- **Entering** and **exiting** the elevator
- ...



Man-made World \neq Smooth

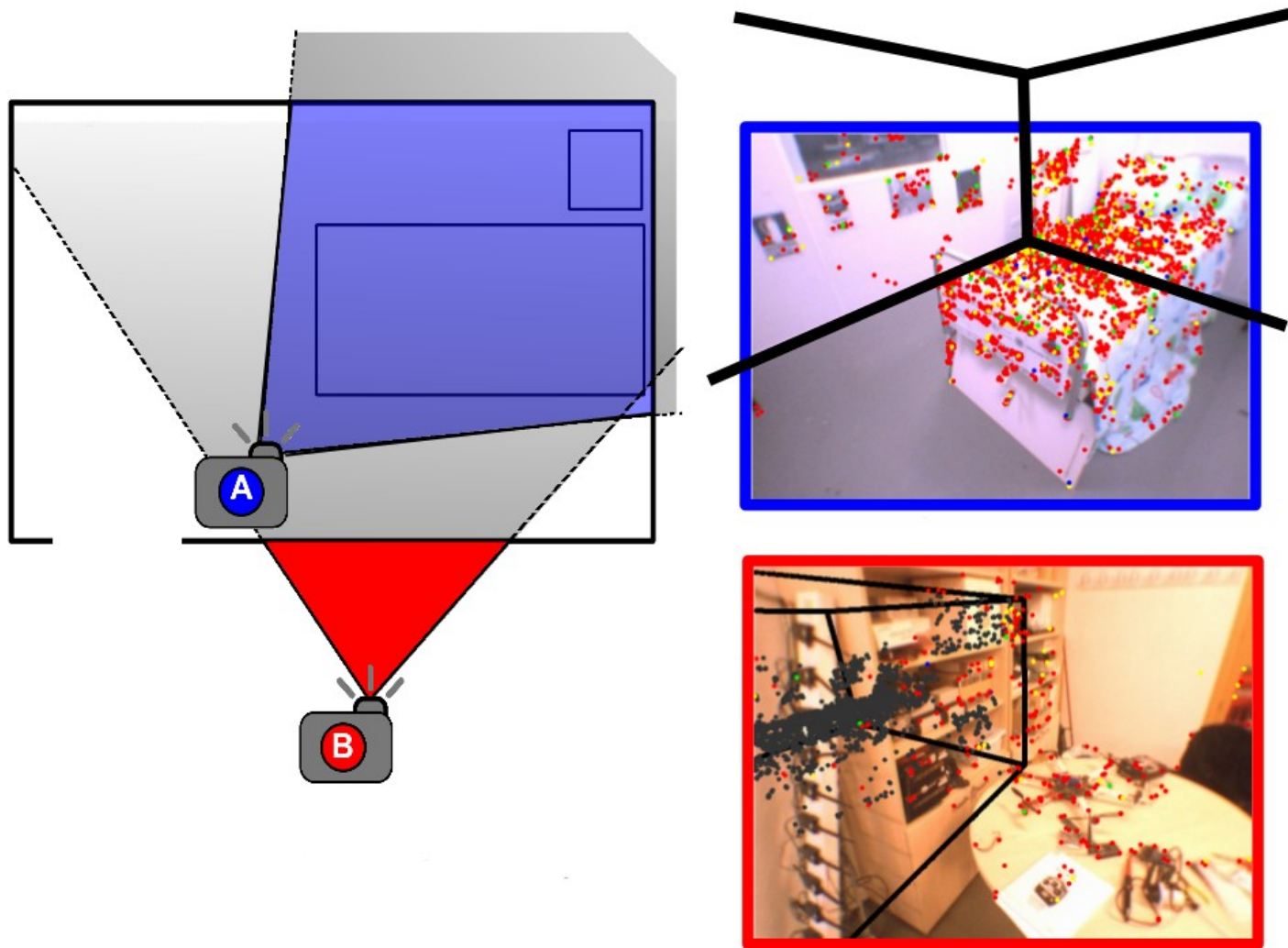


Man-made World \neq Smooth



Occlusion affecting PTAM in room-room transition

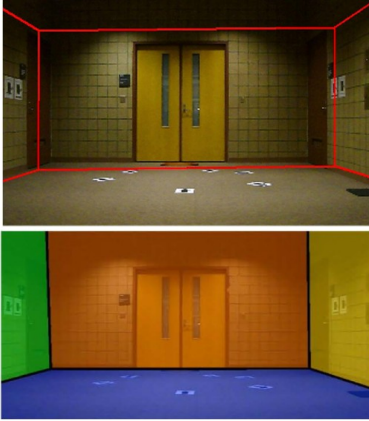
Man-made World \neq Smooth



DTAM = 640×480 pixels \approx 0.5 million

Layout of the Room = Width + Height + Breath + Box pose \approx 6

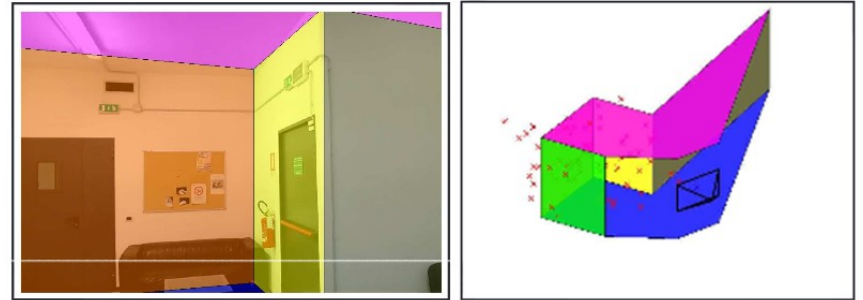
We Need Scene Understanding



Tsai et al. ICCV'11



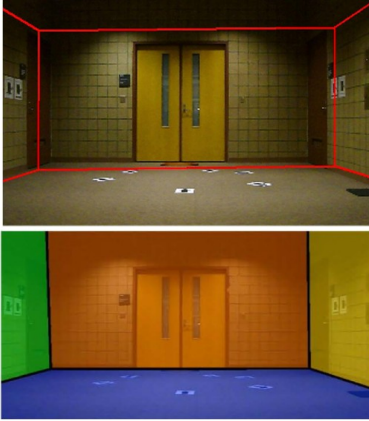
Flint et al. ICCV'11



Furlan et al. BMVC'13

We Need Scene Understanding

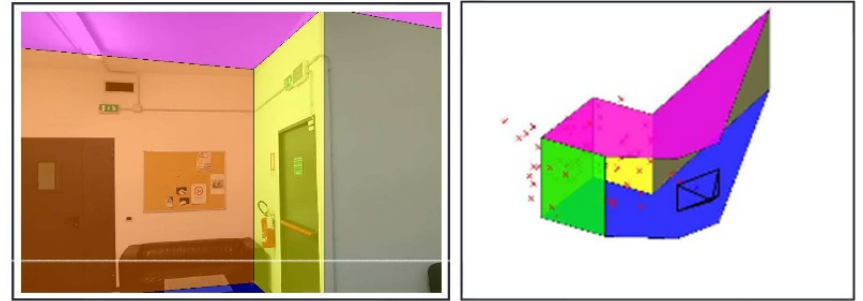
Multi-view Geometry \longrightarrow Scene Understanding



Tsai et al. ICCV'11



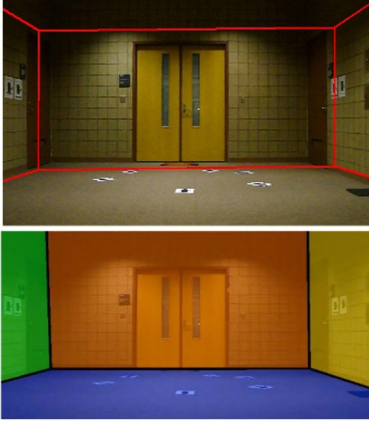
Flint et al. ICCV'11



Furlan et al. BMVC'13

We Need Scene Understanding

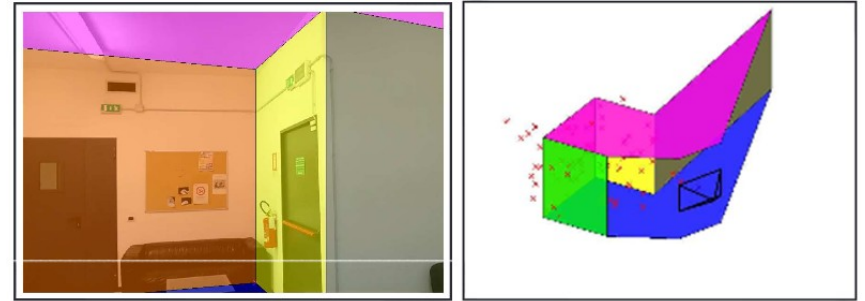
Multi-view Geometry \longrightarrow Scene Understanding



Tsai et al. ICCV'11



Flint et al. ICCV'11

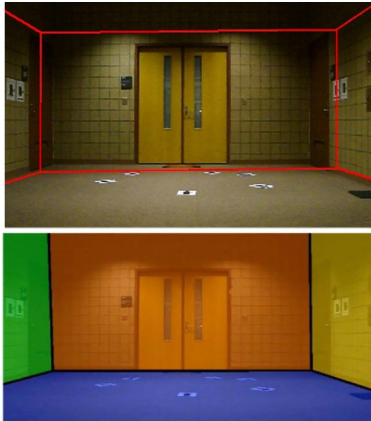


Furlan et al. BMVC'13

Multi-view Geometry \longleftarrow Scene Understanding

We Need Scene Understanding

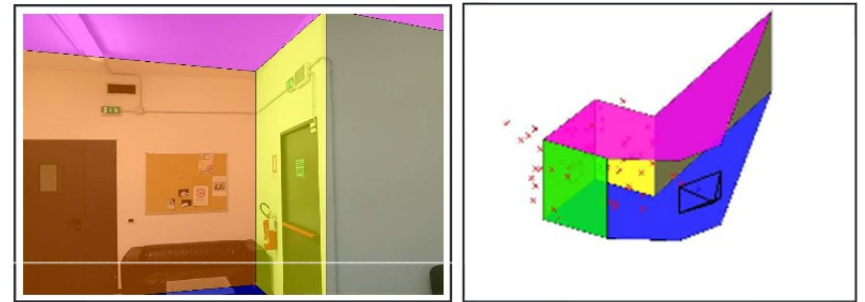
Multi-view Geometry \longrightarrow Scene Understanding



Tsai et al. ICCV'11

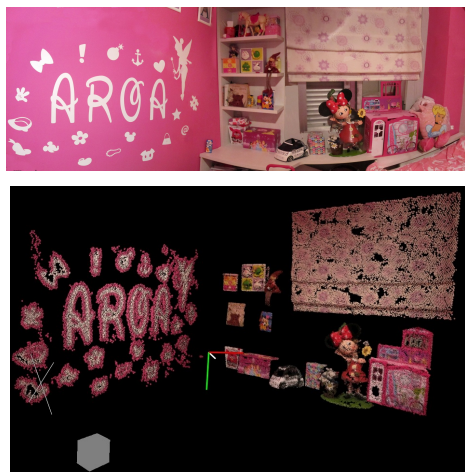


Flint et al. ICCV'11

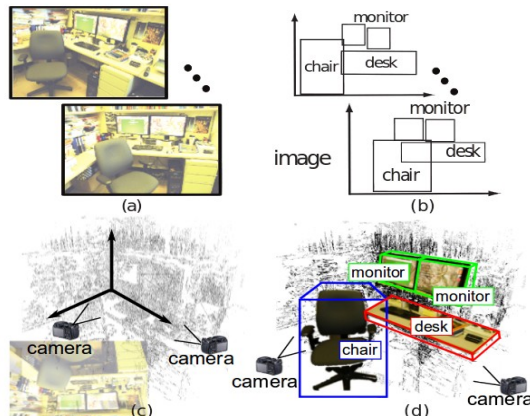


Furlan et al. BMVC'13

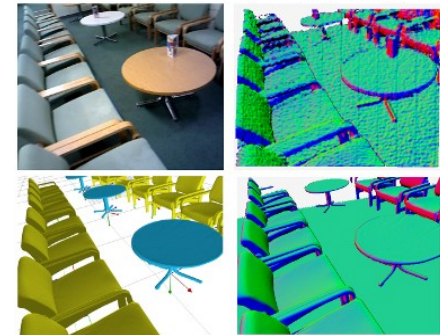
Multi-view Geometry \longleftarrow Scene Understanding



Objects Mono-SLAM
Salas et al. RAS '15



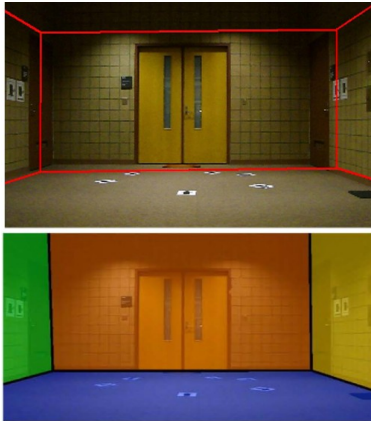
SSfM
Bao et al. CVPR'11



SLAM ++
Moreno et al. CVPR'13

We Need Scene Understanding

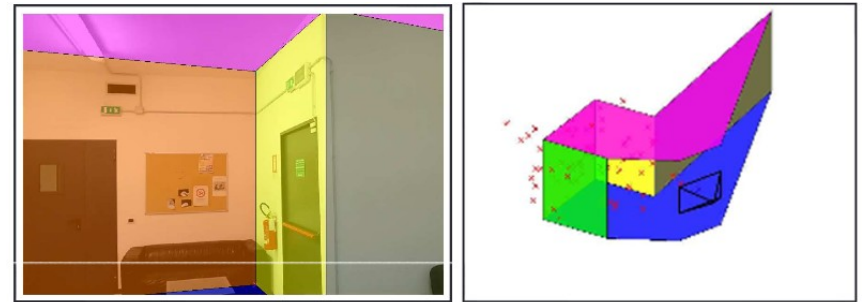
Multi-view Geometry \longrightarrow Scene Understanding



Tsai et al. ICCV'11

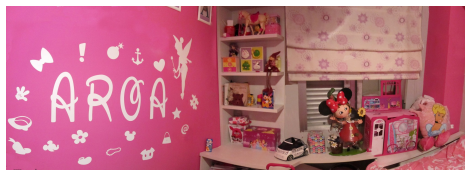


Flint et al. ICCV'11

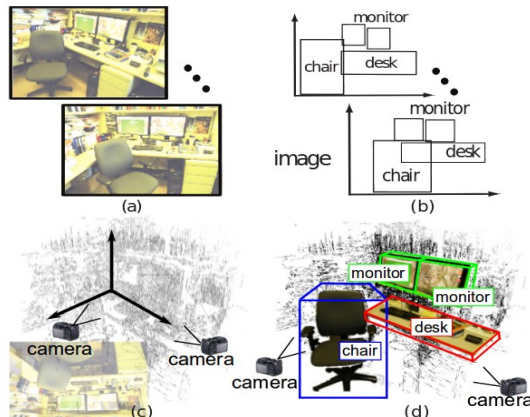


Furlan et al. BMVC'13

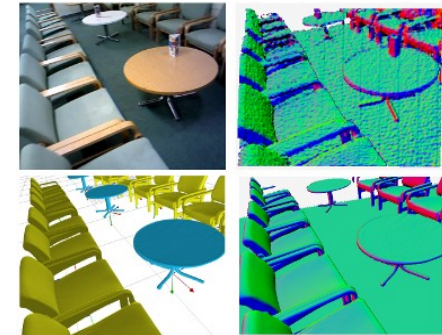
Multi-view Geometry \longleftarrow ~~Scene Understanding~~
Object Level



Objects Mono-SLAM
Salas et al. RAS '15

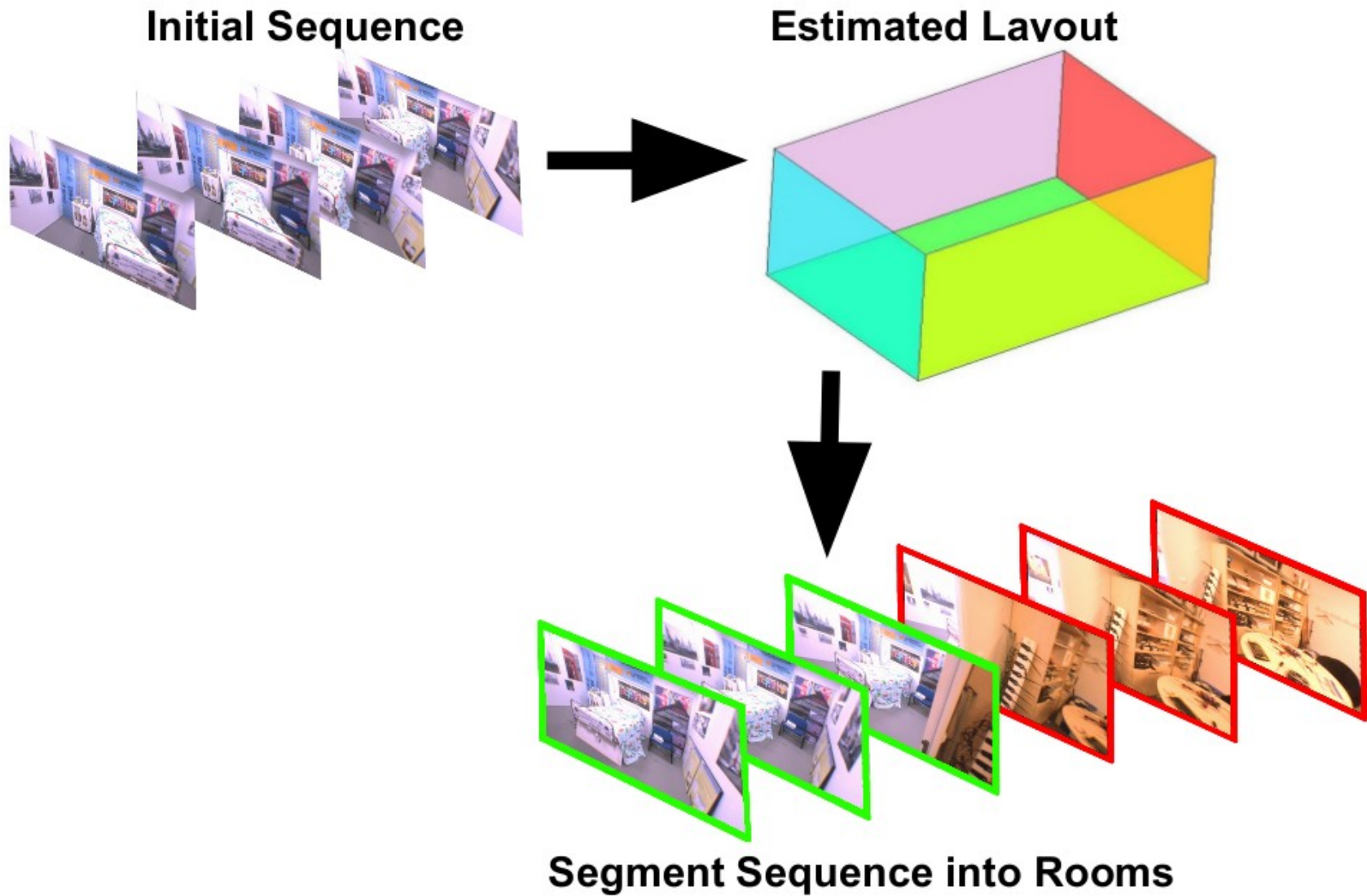


SSfM
Bao et al. CVPR'11



SLAM ++
Moreno et al. CVPR'13

Multi-view Geometry ← Scene Understanding



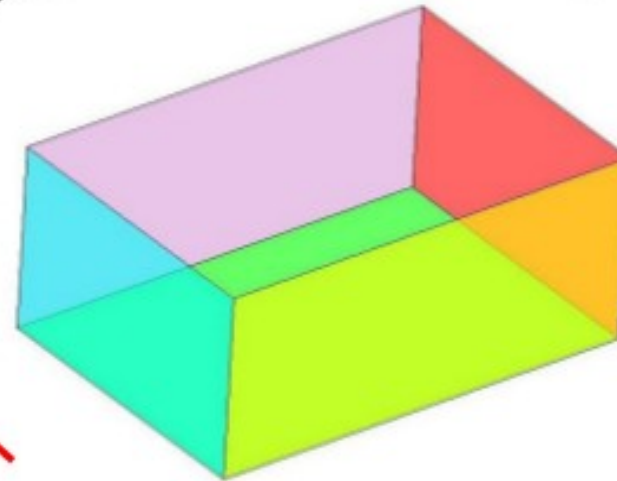
Layout Estimation

**Sparse
Reconstruction**

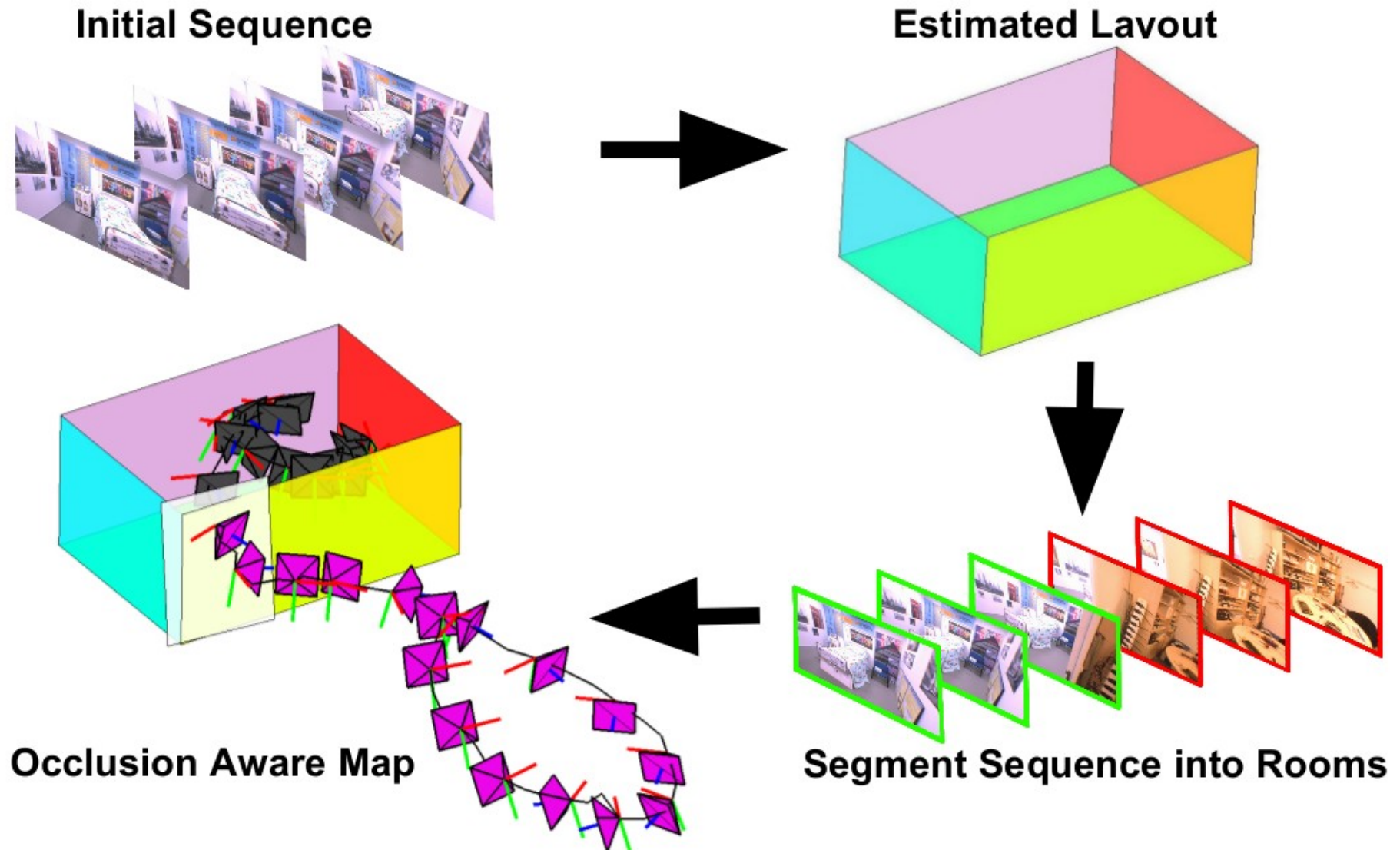


+

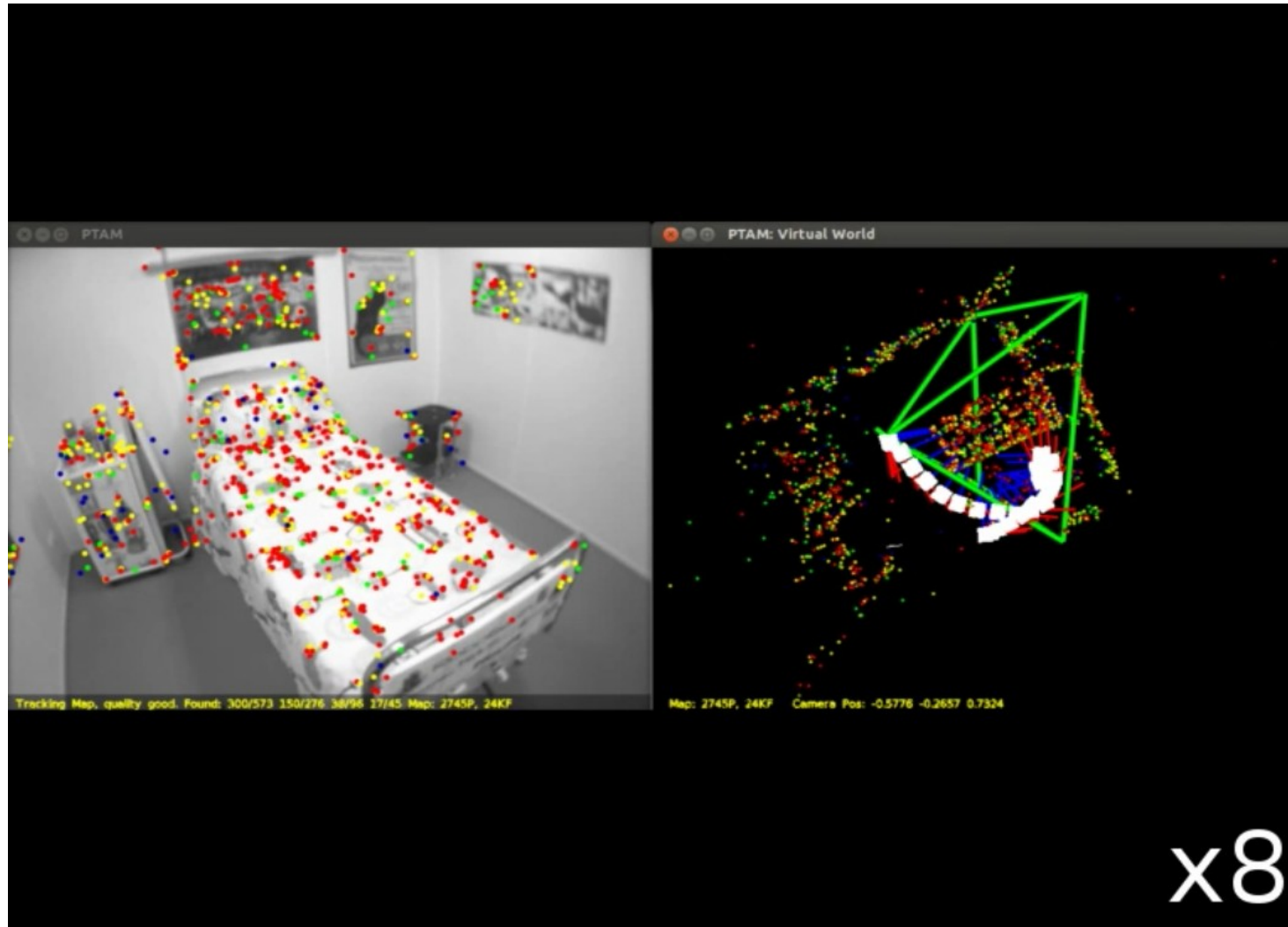
Manhattan World



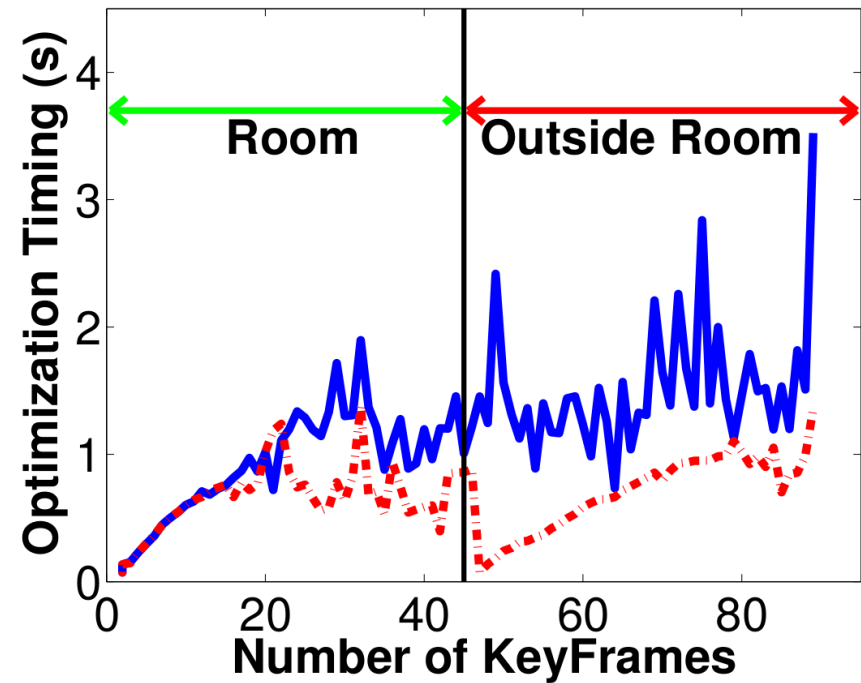
Multi-view Geometry ← Scene Understanding



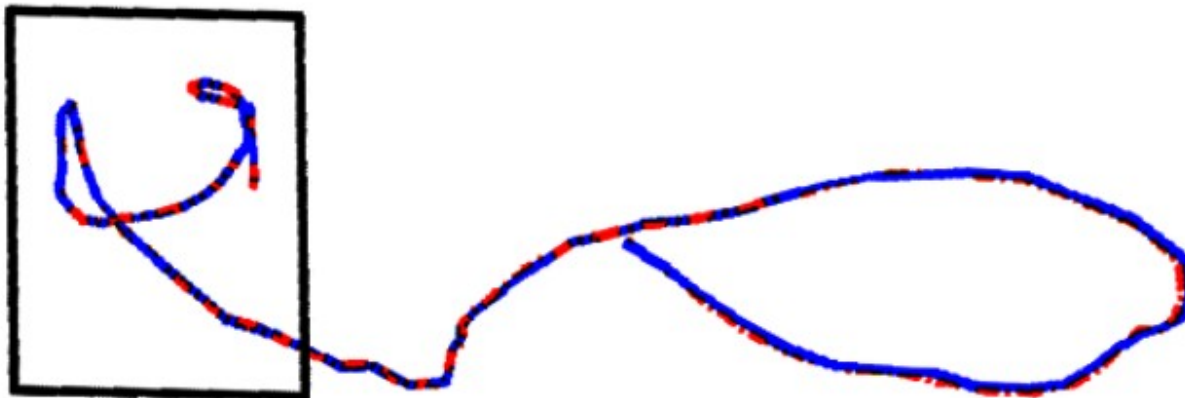
Scene Understanding → Robust Tracking



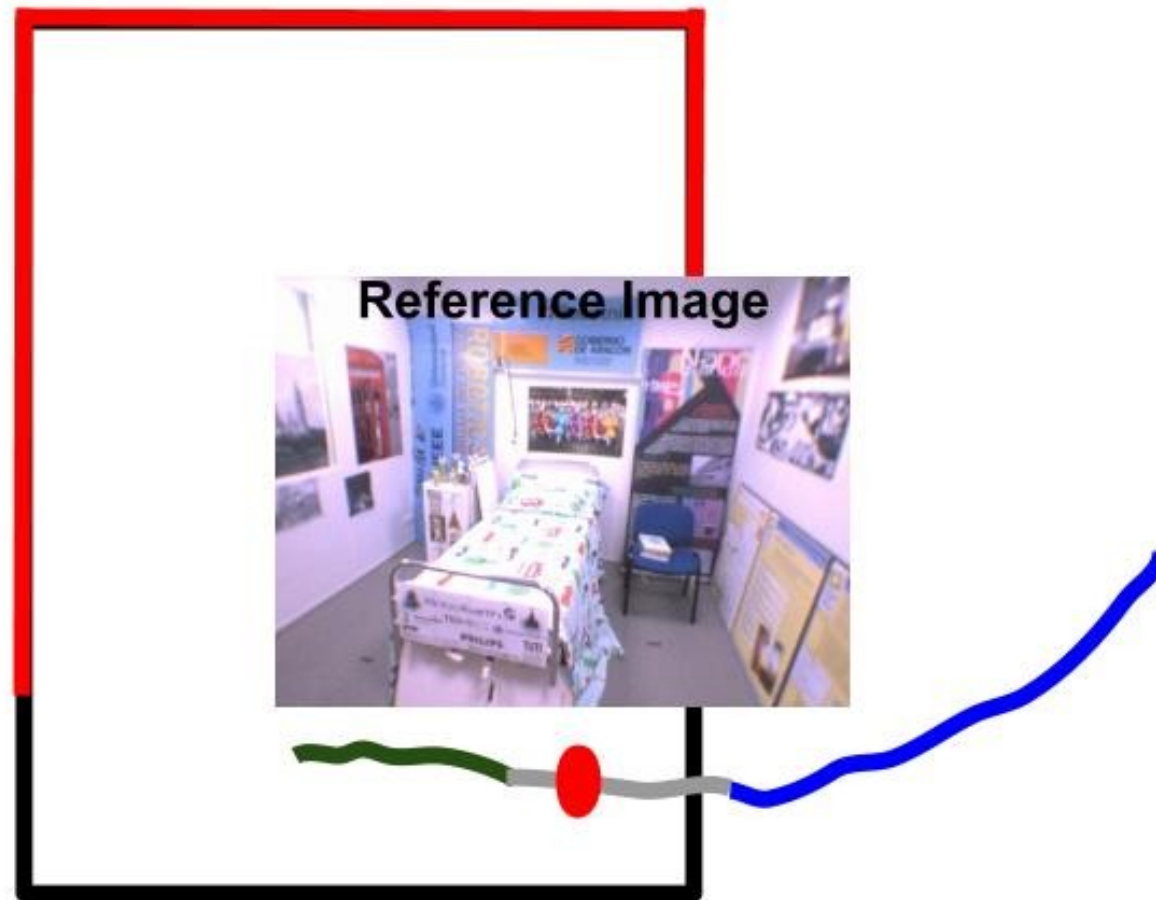
Scene Understanding → Efficient Map Management



- PTAM + Layout
- - - PTAM + Layout + Submapping
- Room Transition

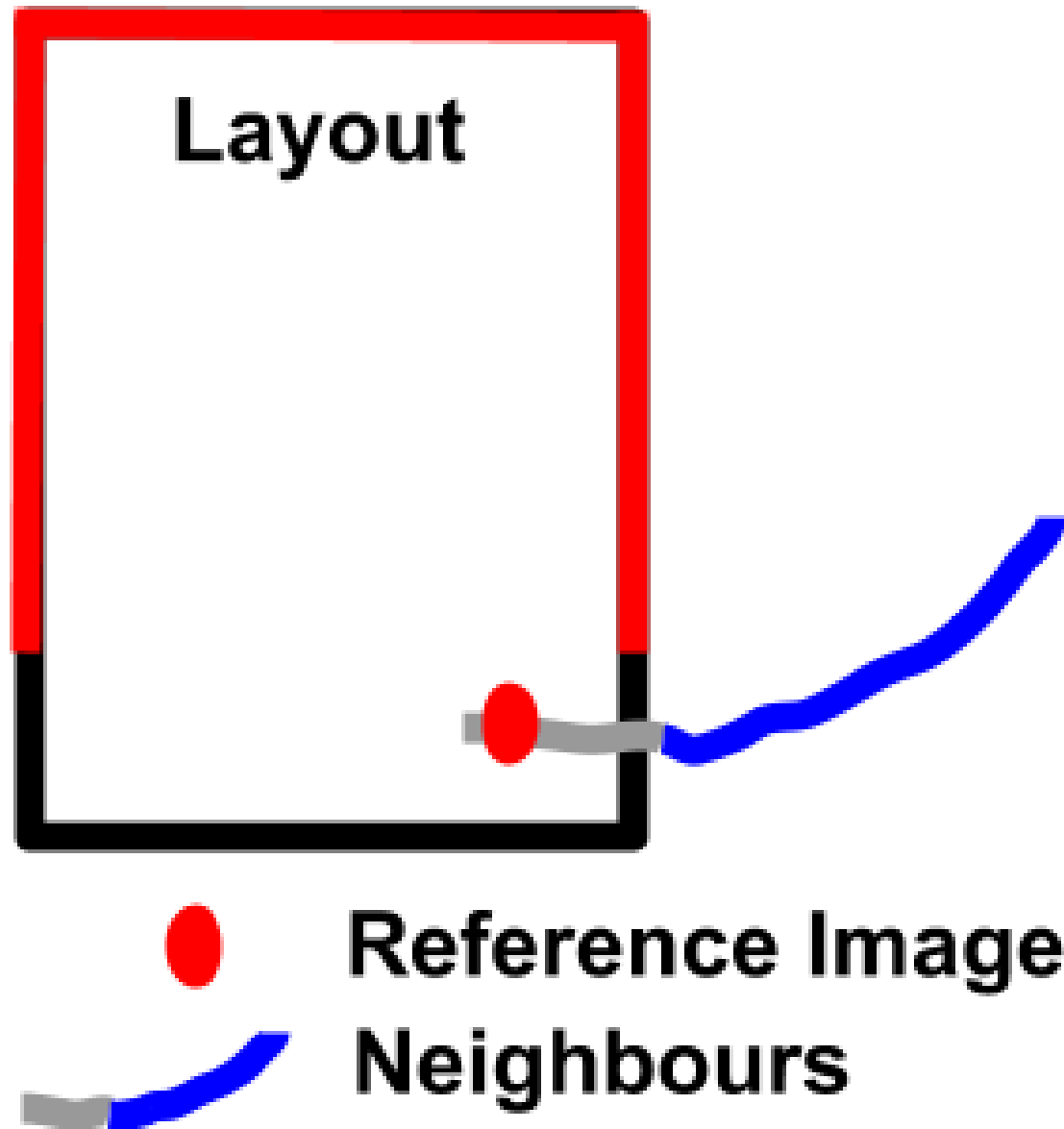


Scene Understanding → Better Dense Reconstruction

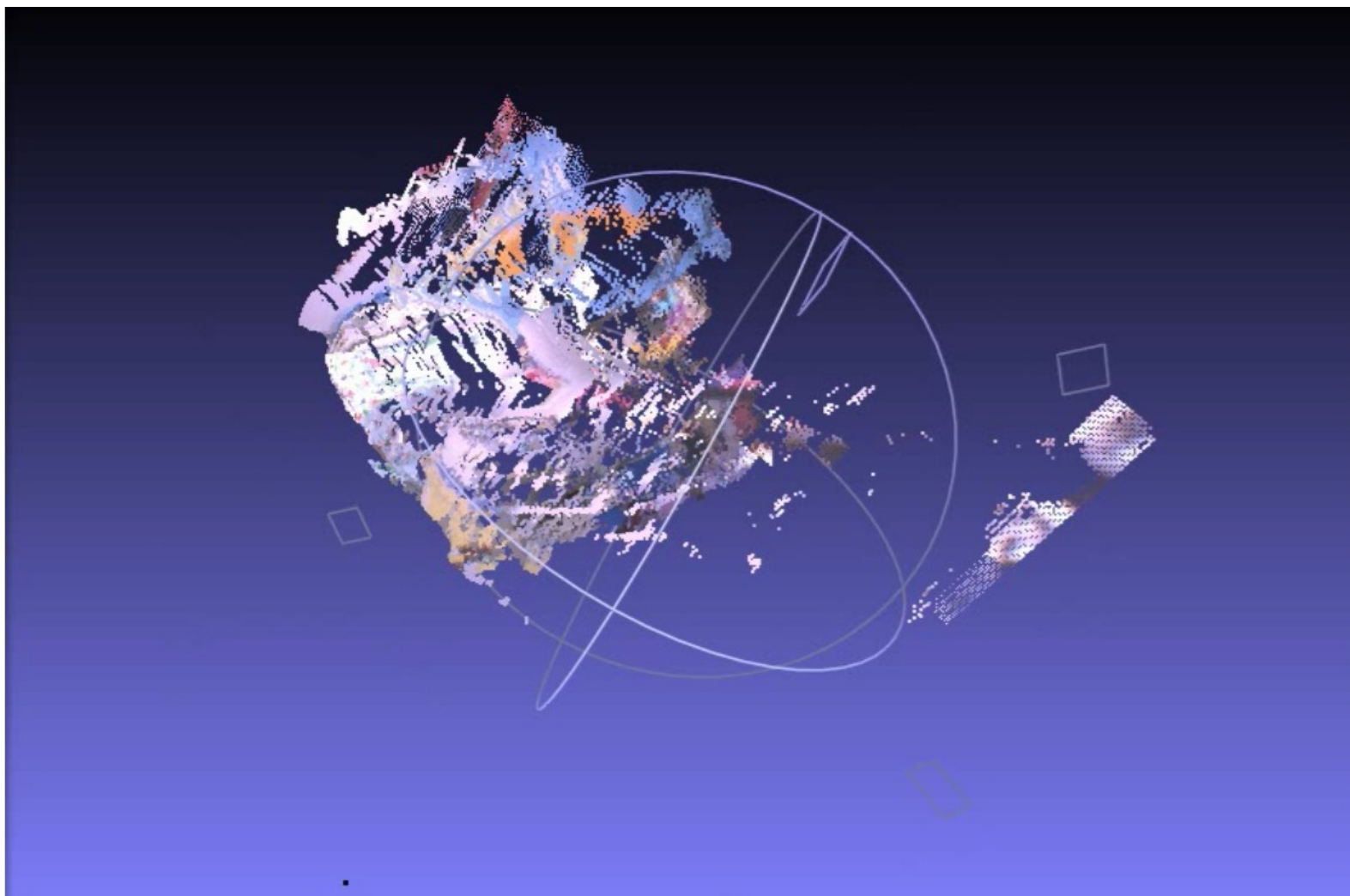


-  Naive neighbours selection for Bundle Adjustment
-  Layout conscious neighbours selection for BA

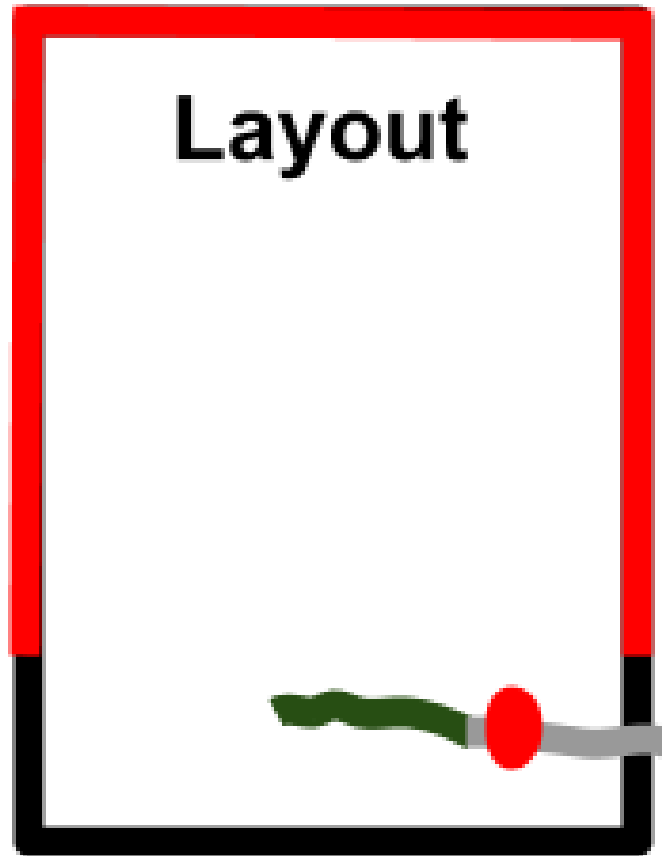
Scene Understanding → Better Dense Reconstruction



Scene Understanding → Better Dense Reconstruction



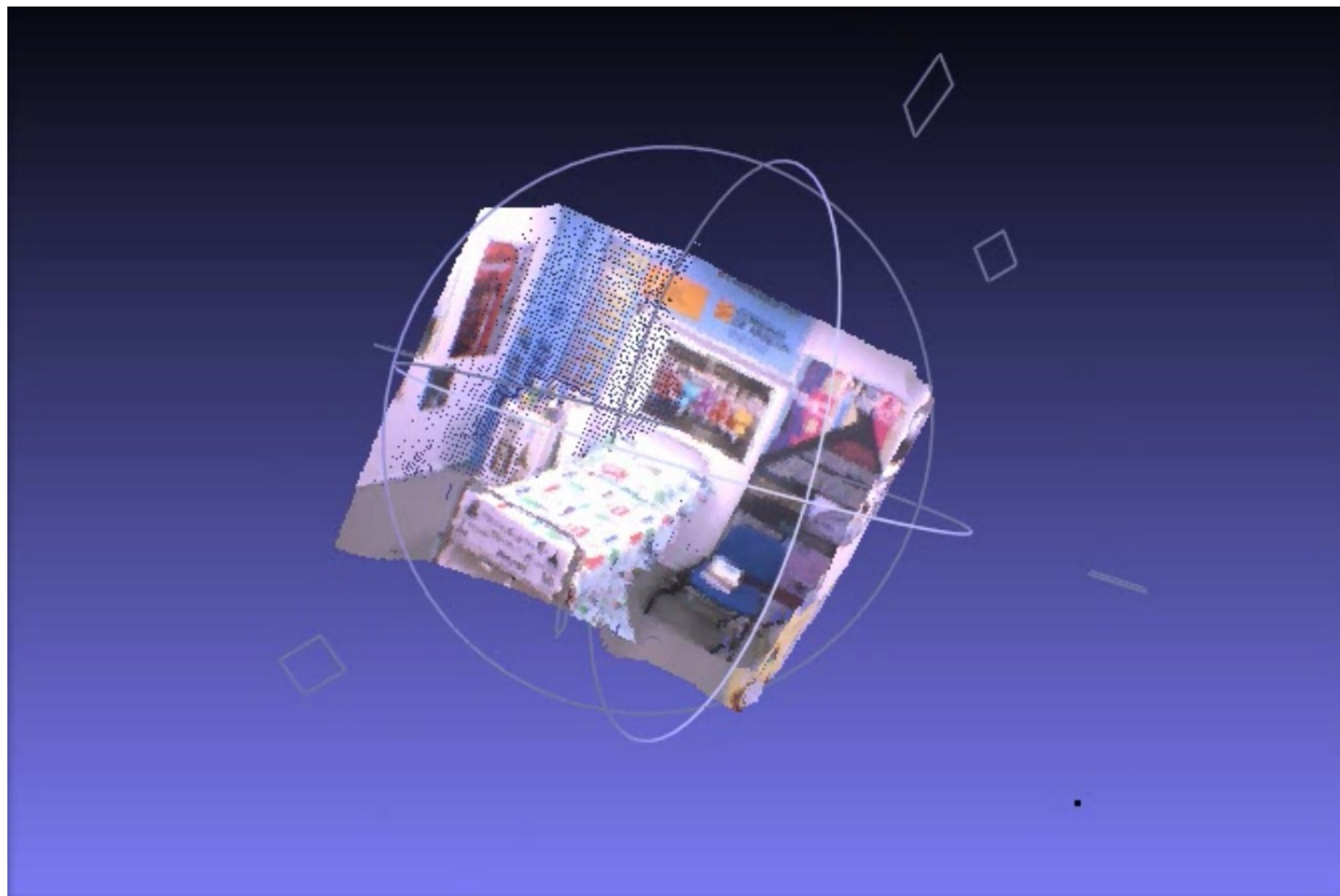
Scene Understanding → Better Dense Reconstruction



Reference Image

Neighbours

Scene Understanding → Better Dense Reconstruction



Conclusions

Multi-view Geometry ← Scene Understanding

Introduction of box layout reasoning in sequential mapping process has three advantages:

- Scene Understanding → Robust Occlusion Aware Tracking
- Scene Understanding → Efficient Map management
- Scene Understanding → Better Dense Reconstruction

Thank you!

