Summary of

"Data Processing Algorithm for Generating 3D building Facade Meshes From Laser Scans and Camera Images". An article by Christian Frueh, Siddharth Jain, Avideh Zakhor

Ilya Landa

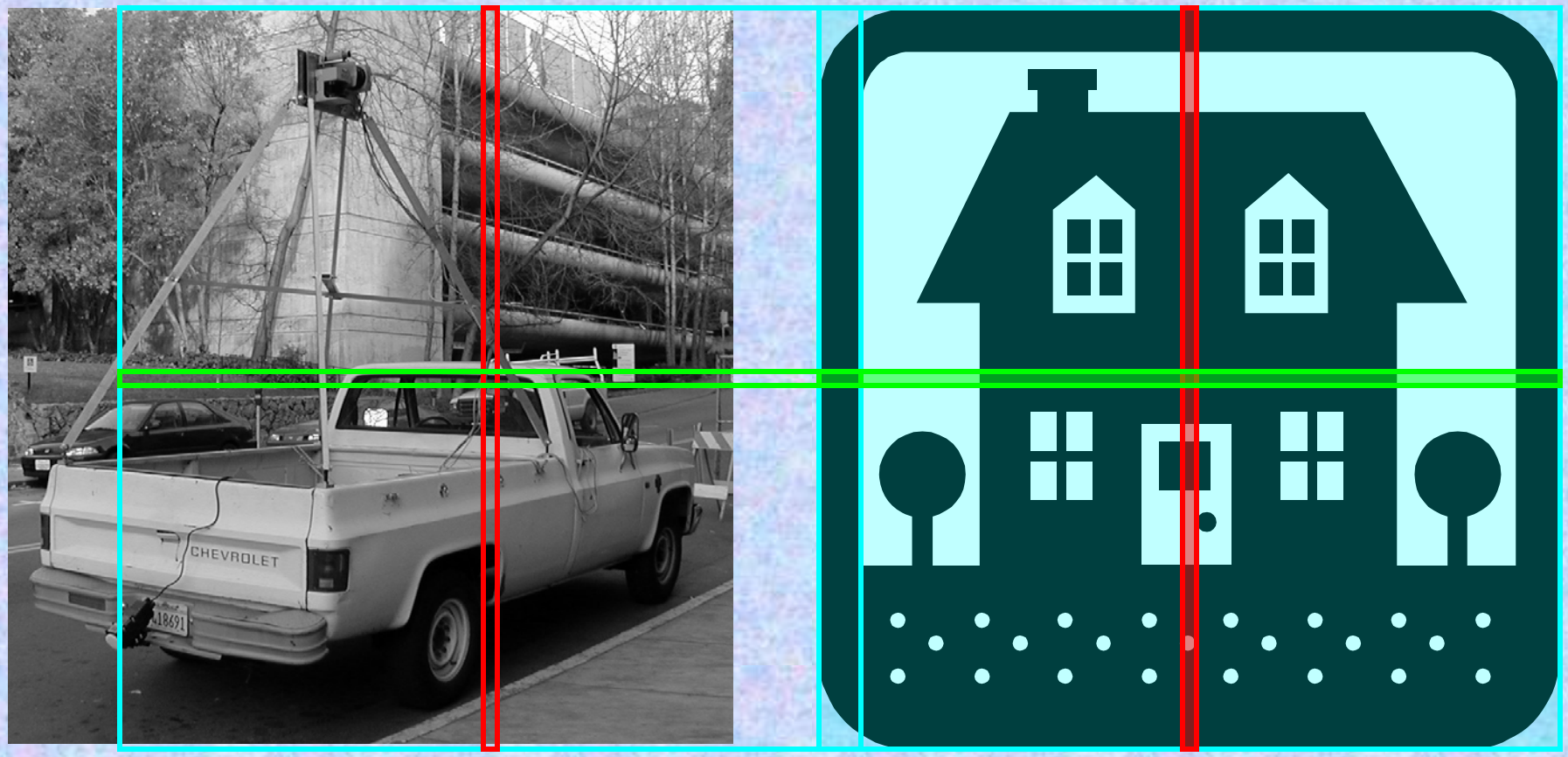
03/30/2008

Overview

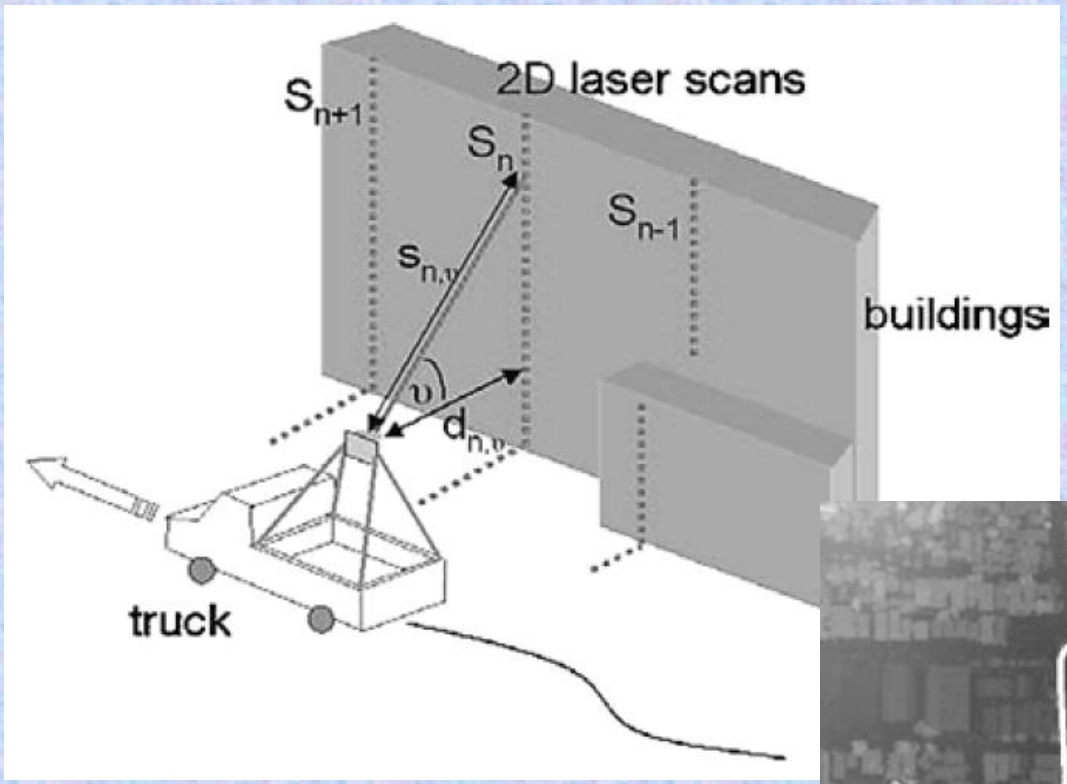
- The need for creating 3D models of urban environments
- Current methods
  - Aerial Photography
  - Vision Based Methods
  - Robot Mounted 2D/3D Lasers
  - Van Mounted Lasers Equipped With GPS

Experiment Setup

- Vertical 2D laser
- Horizontal 2D laser
- Digital Camera



Experiment Setup

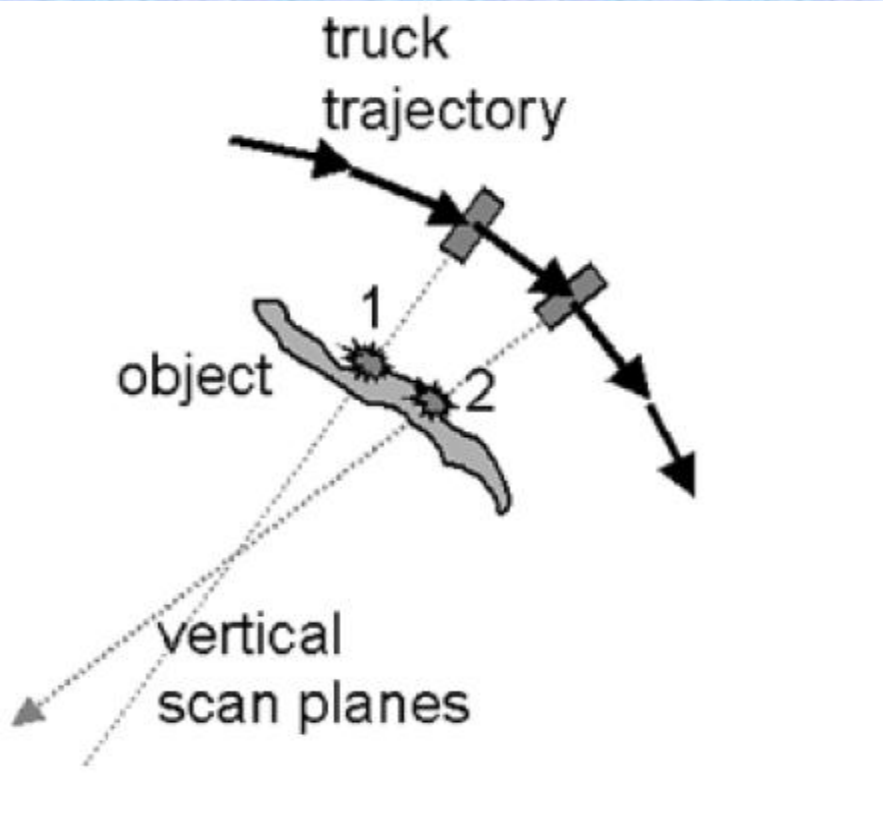


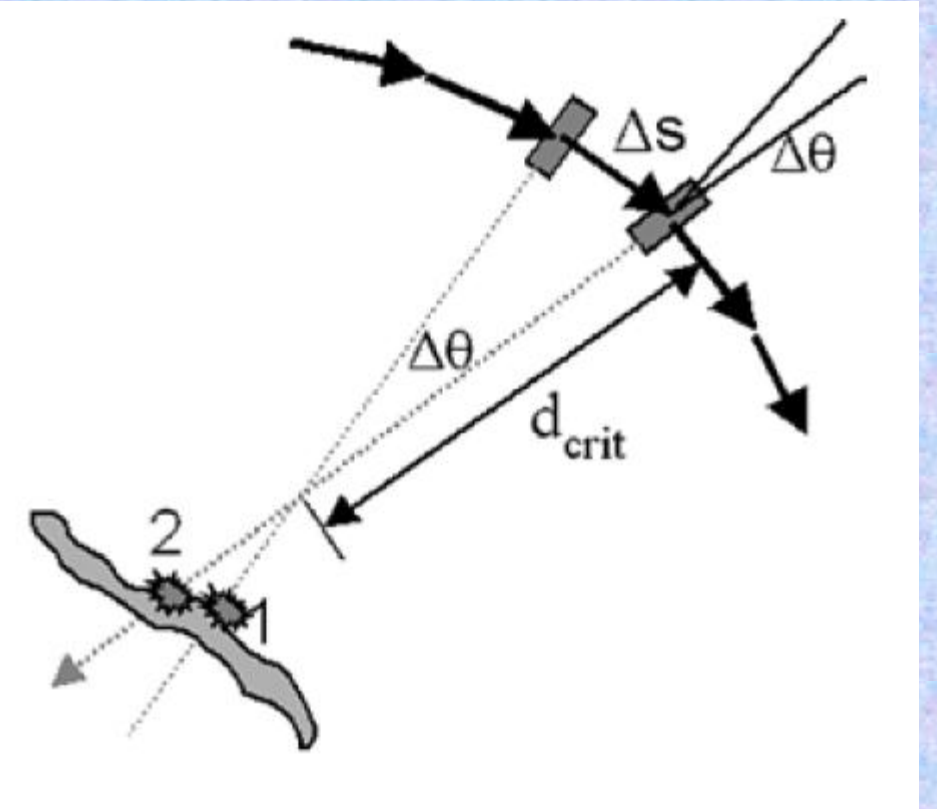
Problems and Complications

Raw Triangulation

Occlusion

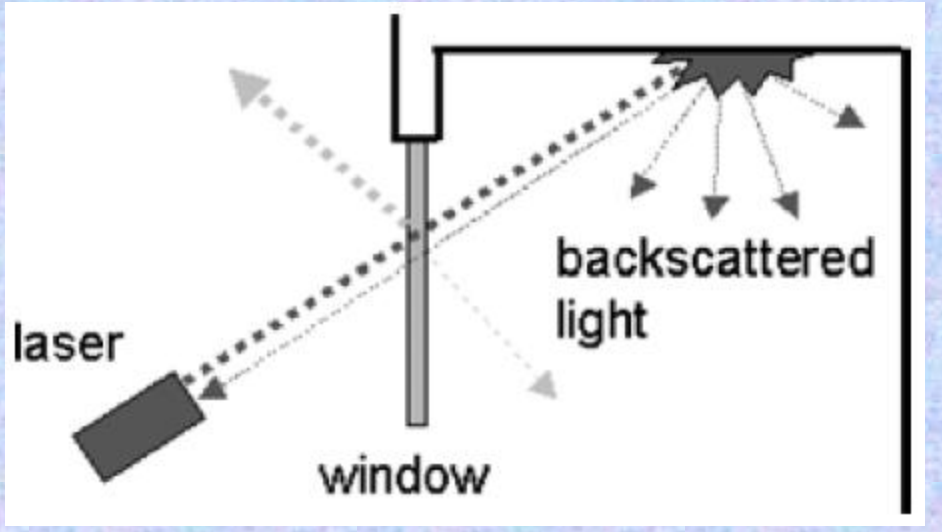
Reverse Order Scans





$$d_{crit} = \frac{\Delta s}{\sin(\Delta\theta)}$$

Reflective or Transparent Surfaces

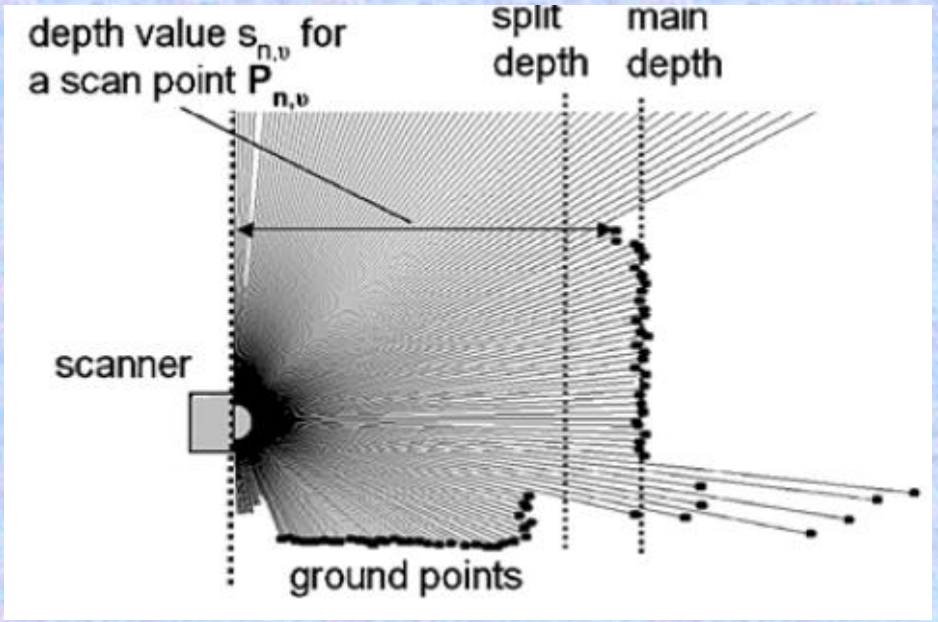


Organizing Scan Points

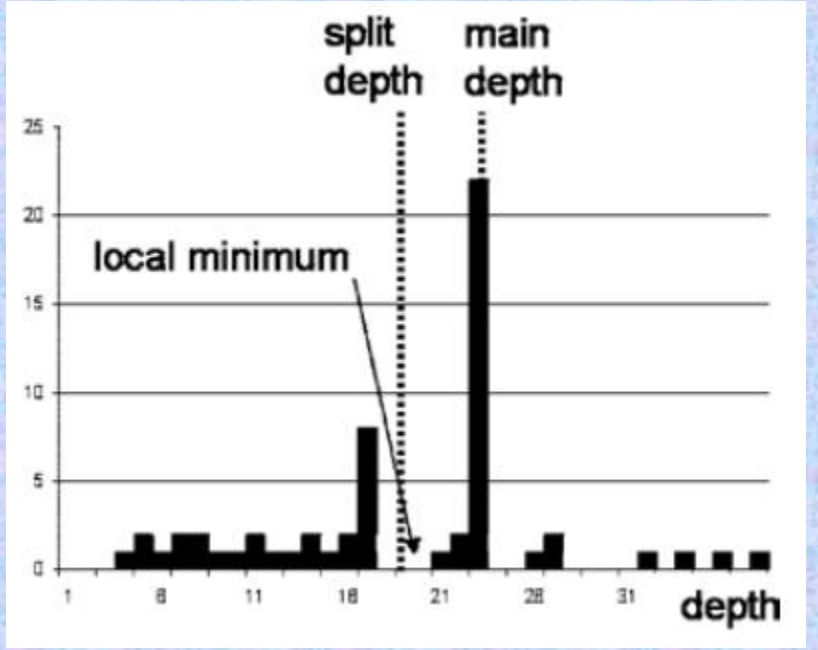
Downtown Assumptions

- Buildings have relatively flat facades that are parallel to the road, thus perpendicular to the scans
- Ground is a horizontal plane in all scans
- Surveyed landscapes are not dominated by trees

Depth Levels

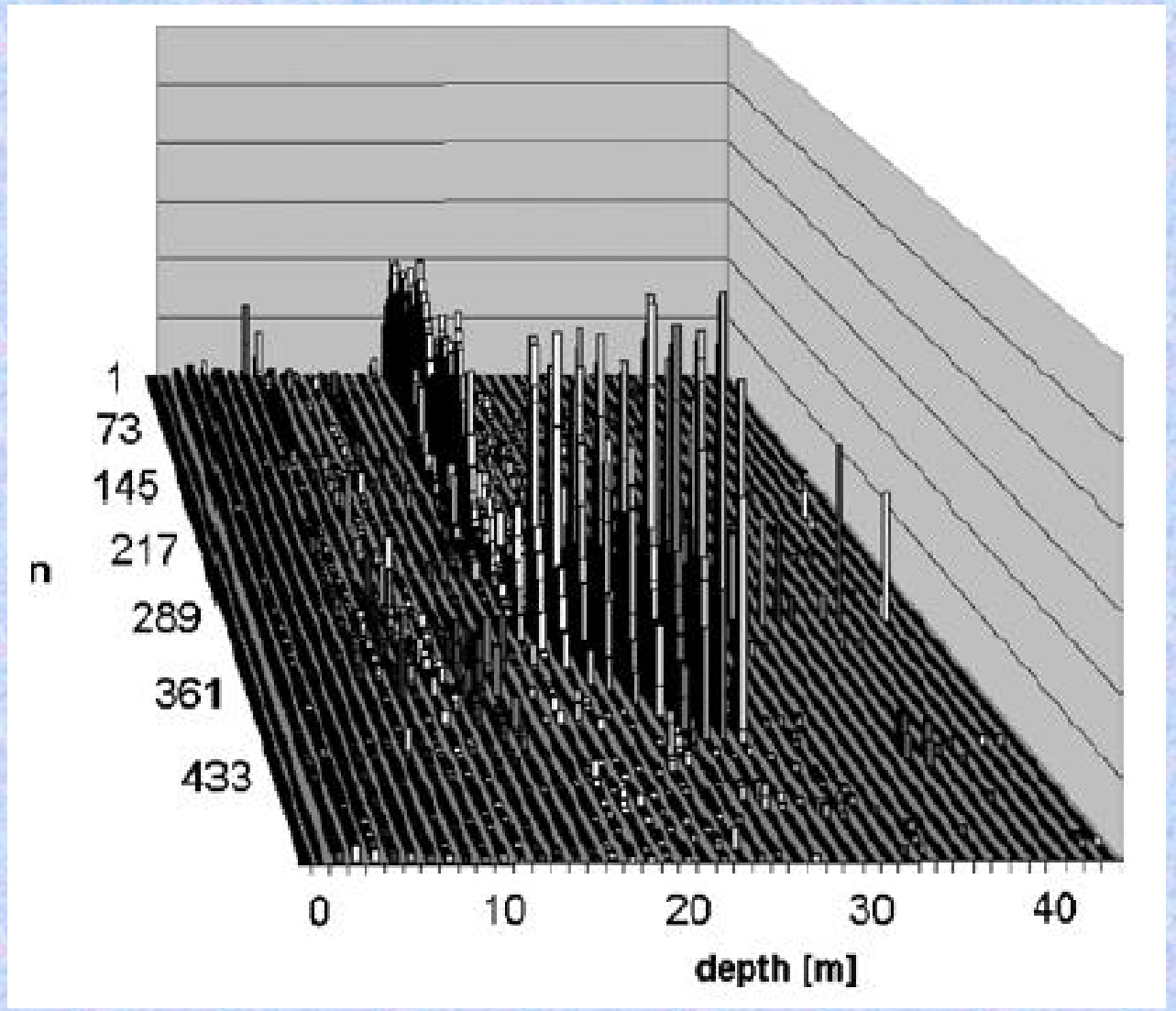


- Main Depth – most frequent value
- Split Depth – local minimum
- Background Layer – around main depth
- Foreground Layer – trees, cars, etc.
- Ground Level



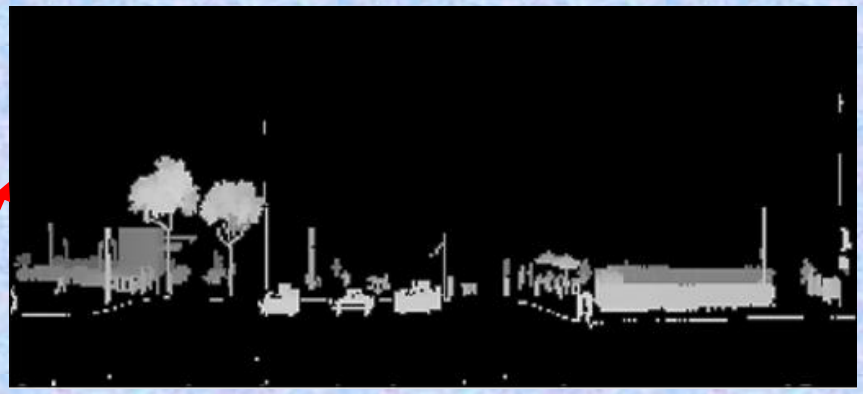
☺

Accumulative Histogram



Results of the Split

Raw Points

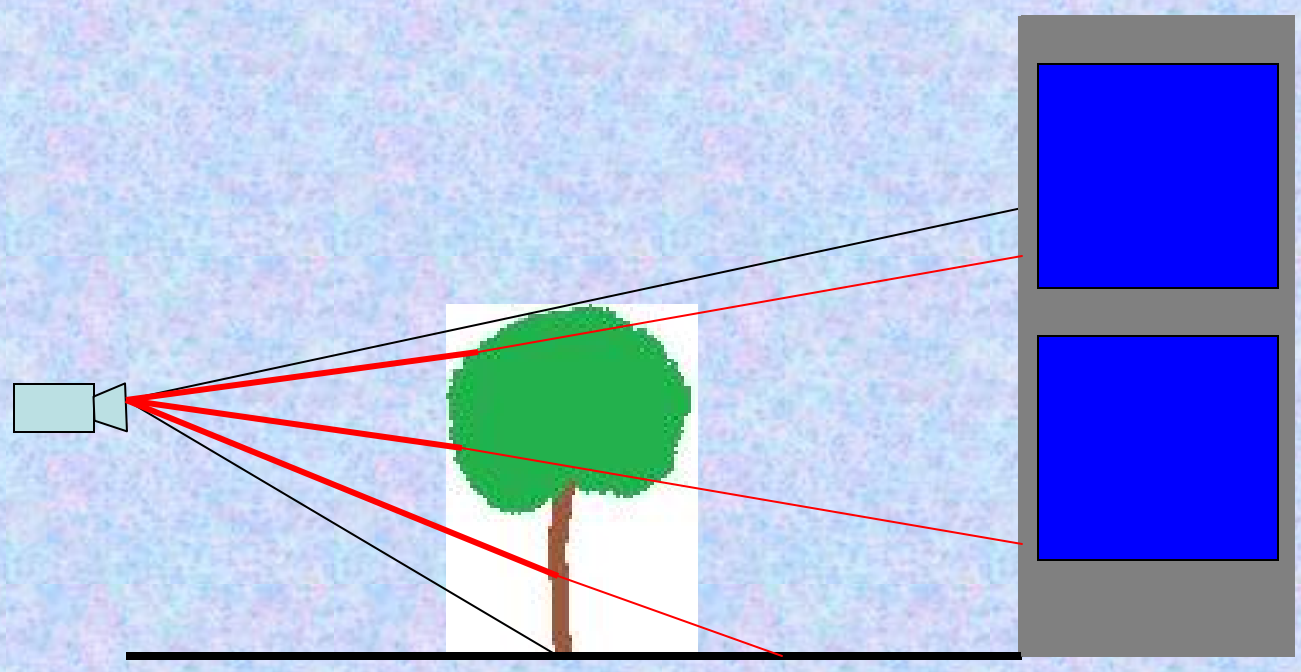


Foreground Layer

Horizontal Laser Points Added

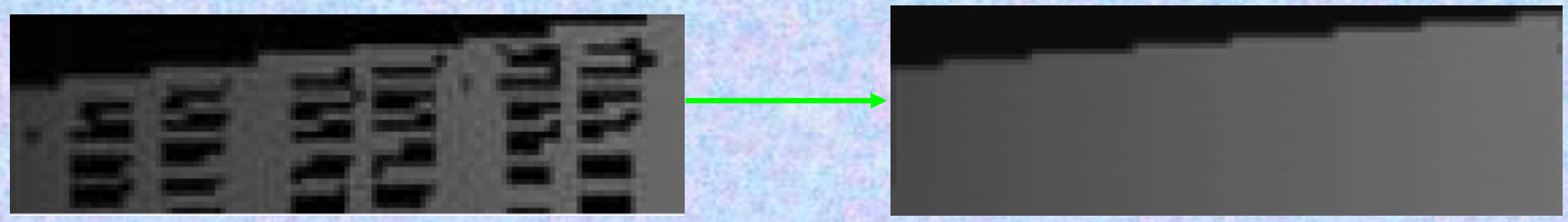
Background Layer + Ground Points

Projecting Foreground Objects onto the background and ground layers

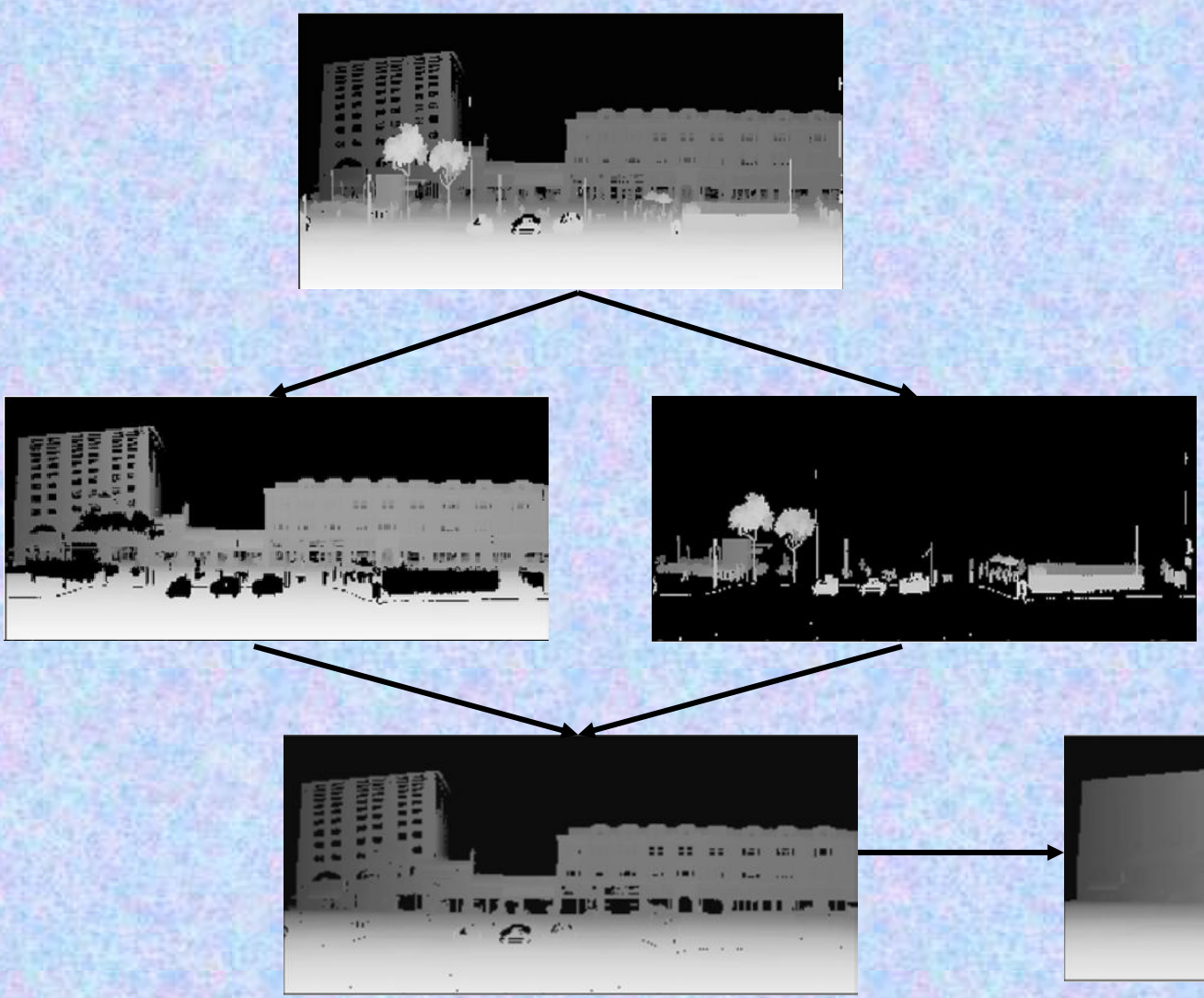


Removing Window Holes

- Scanning a window results in a series of points with a random and large depth.
- If such points are in between points on the main depth, the hole can be eliminated.

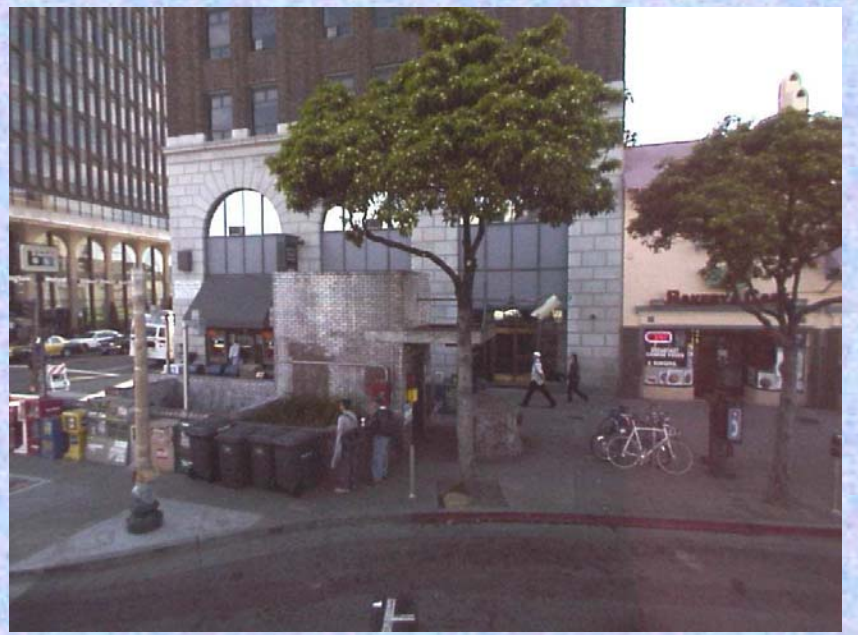


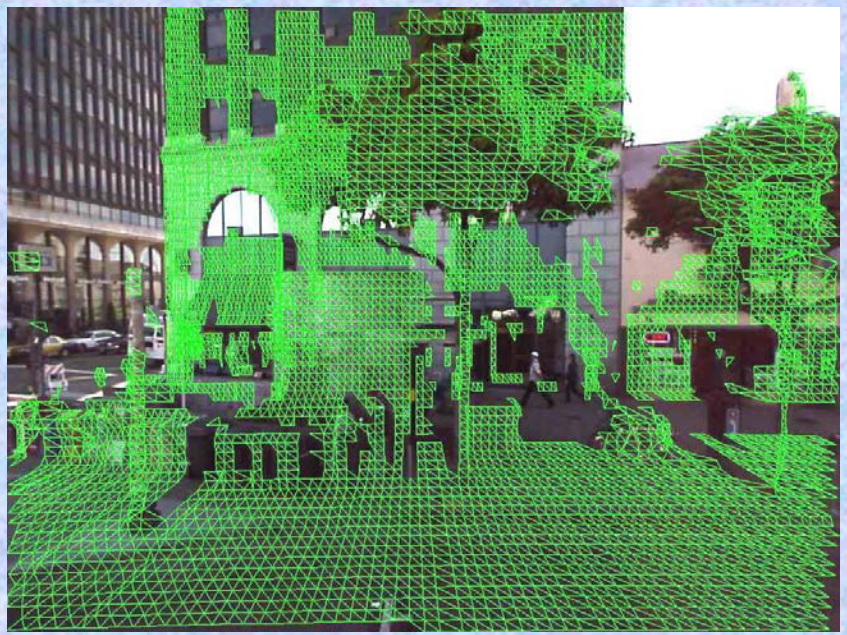
Point Improvement Overview



Texture Generation

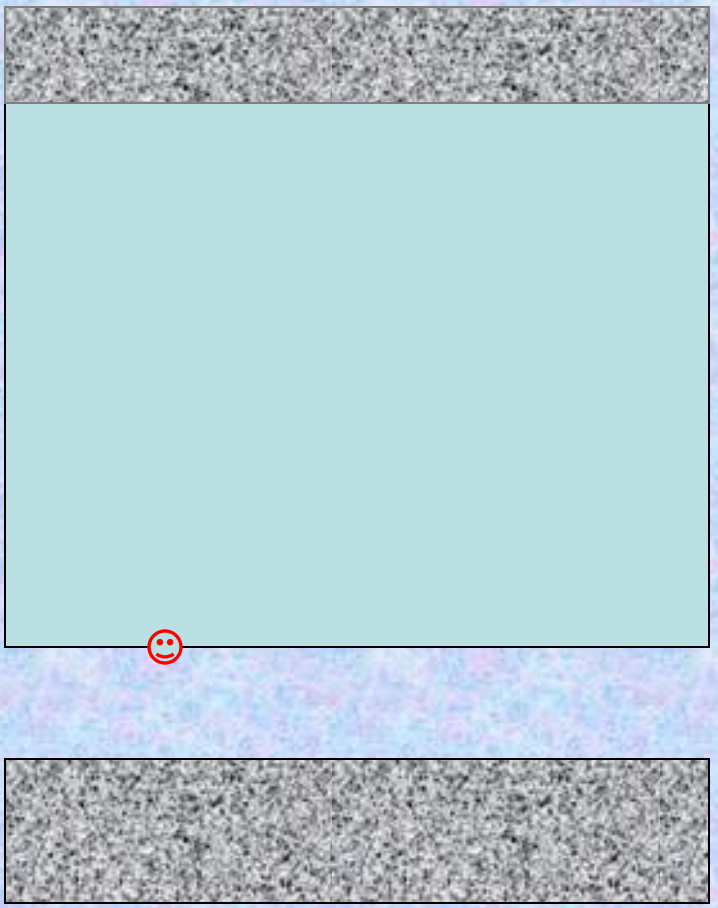
Camera Data



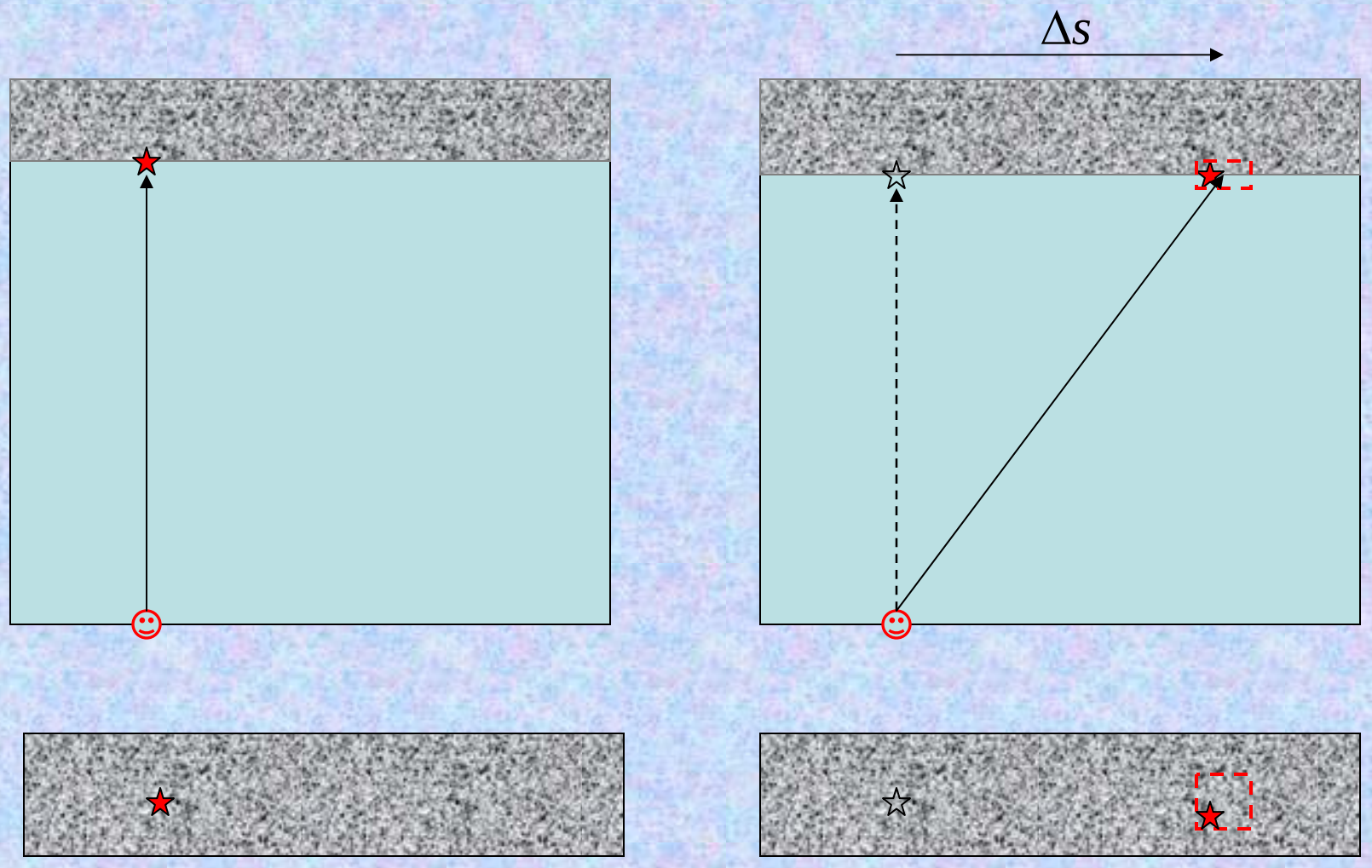


Naive Foreground Removal

Background / Foreground Splitting Setup

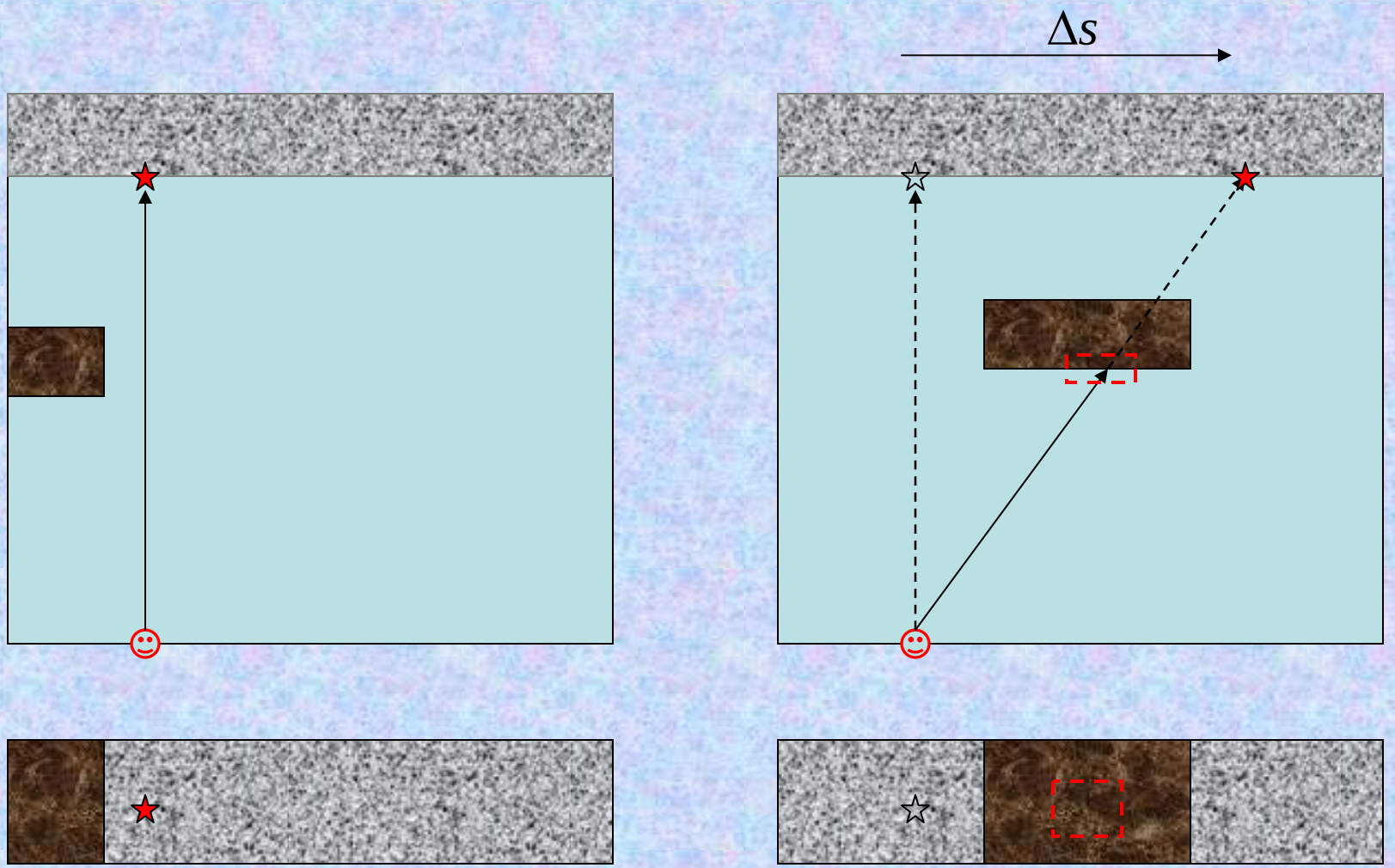


Background / Foreground Splitting
No Obstacles



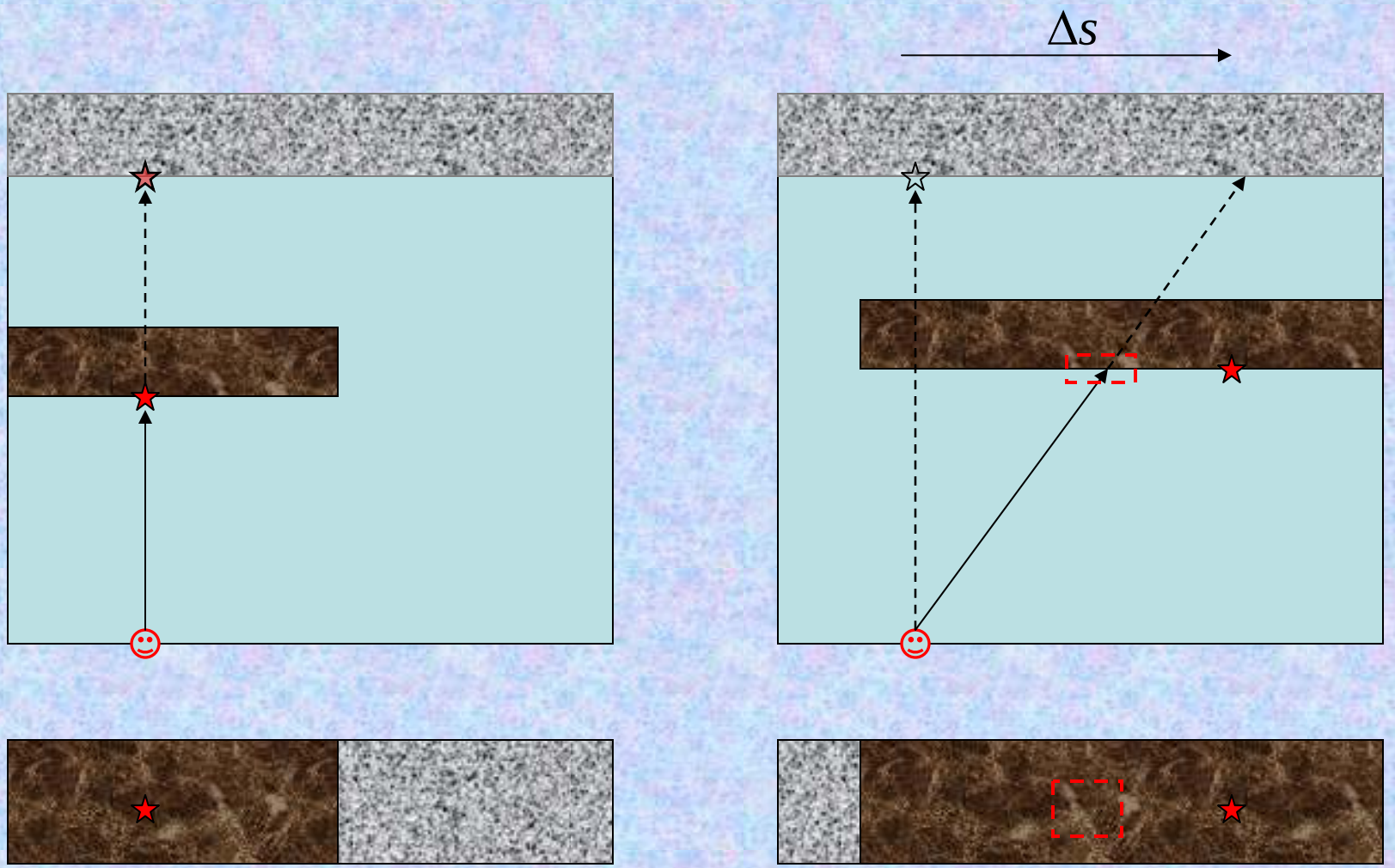
No Obstacles Example

Background / Foreground Splitting Small Obstacle

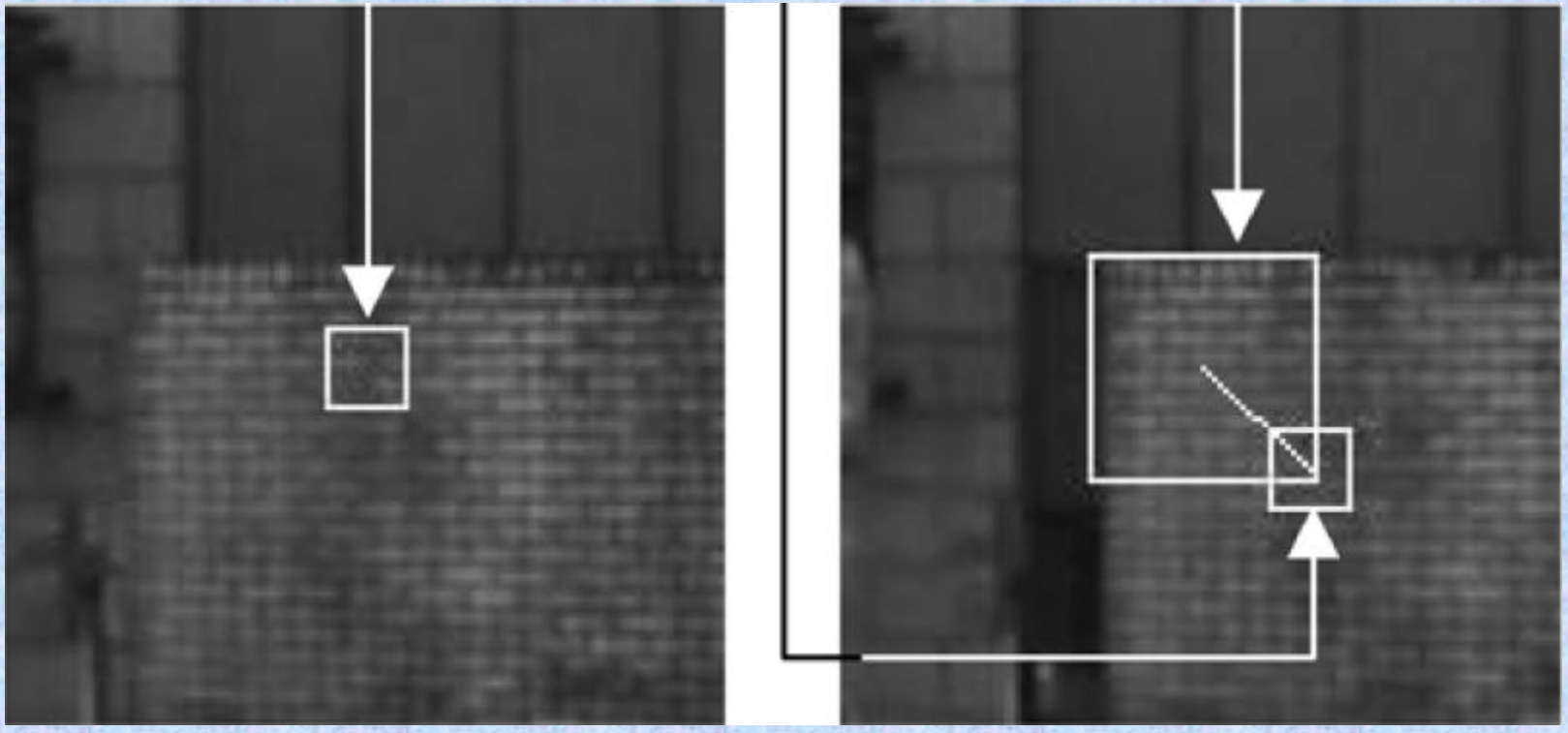


Small Obstacle Example

Background / Foreground Splitting Large Obstacle



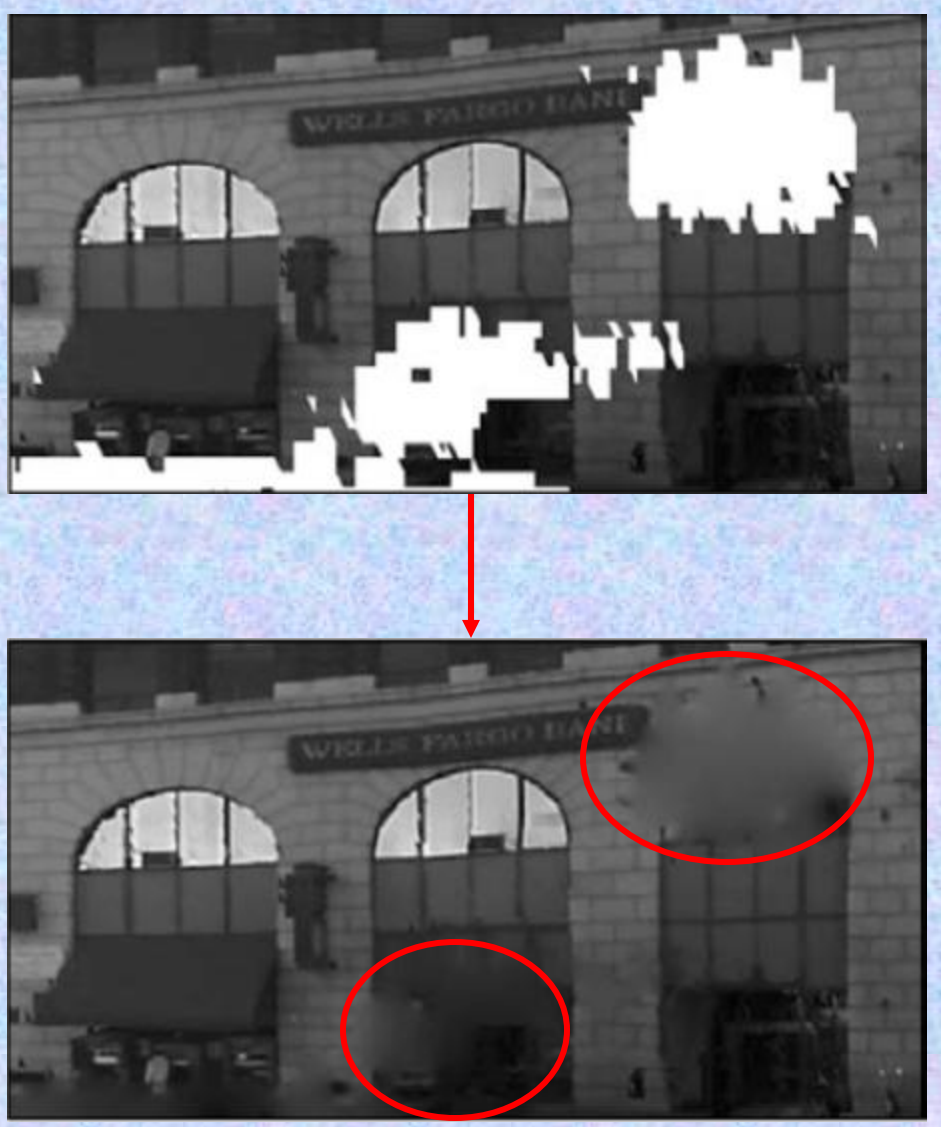
Large Obstacle Example



Split Results

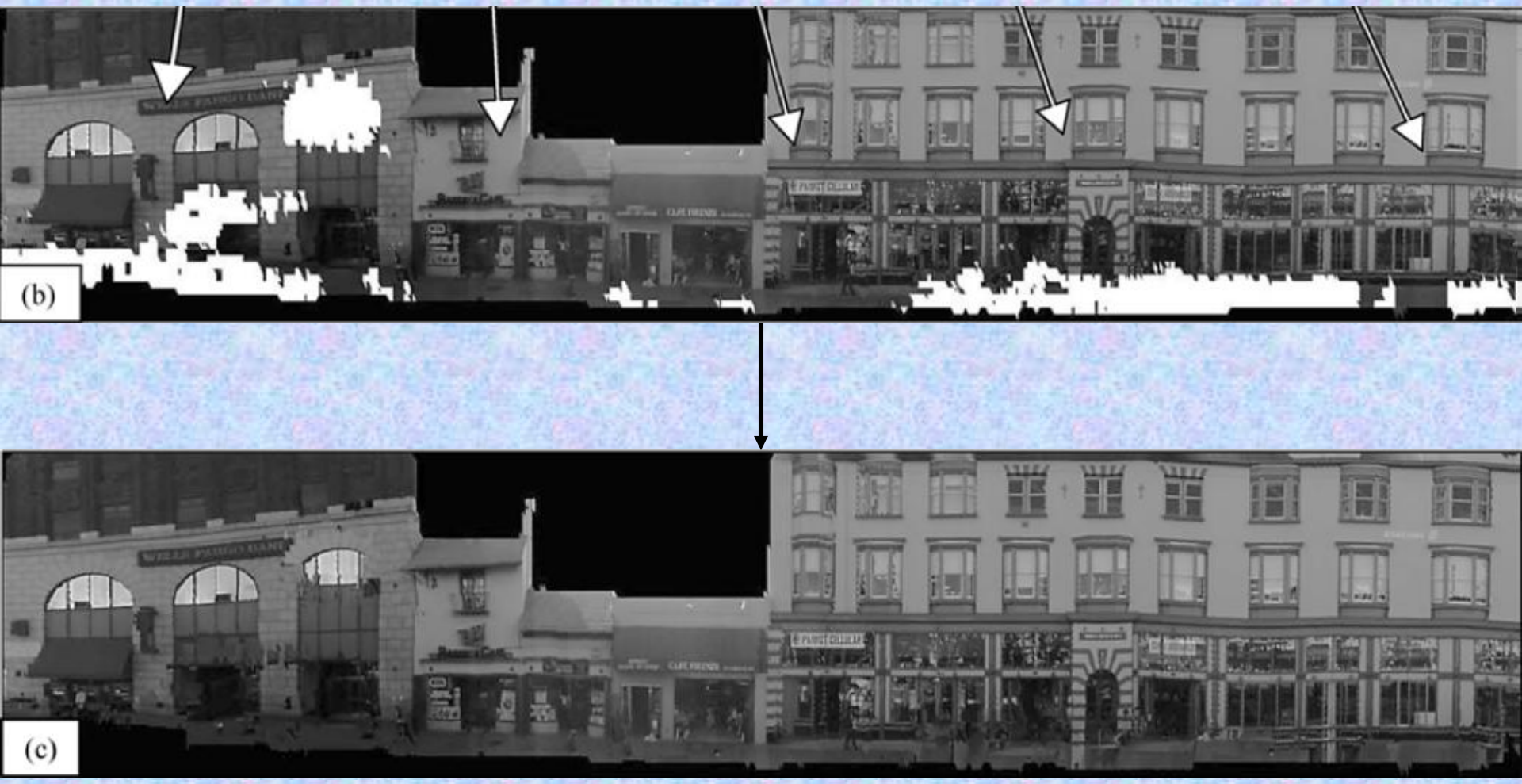
Combining Split Photos

Linear Hole Filling

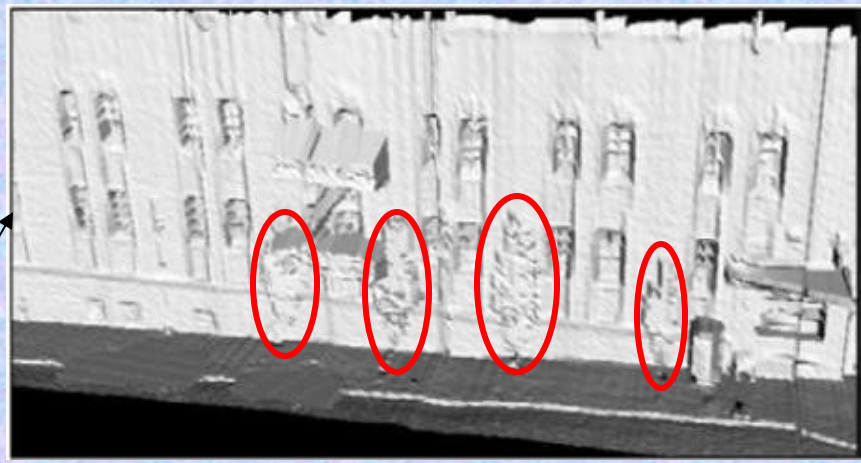


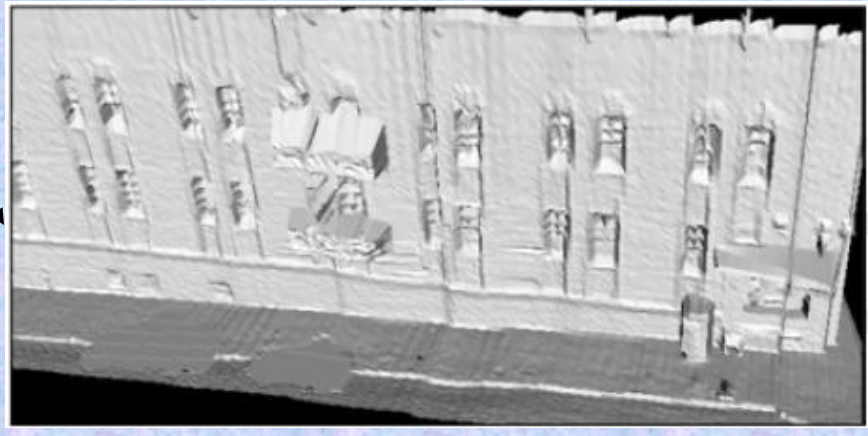
Copy-Paste

Final Texture Atlas



Quality Comparison



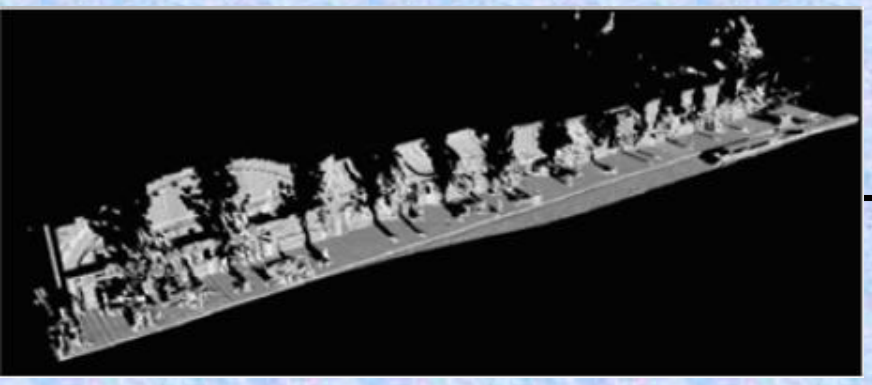


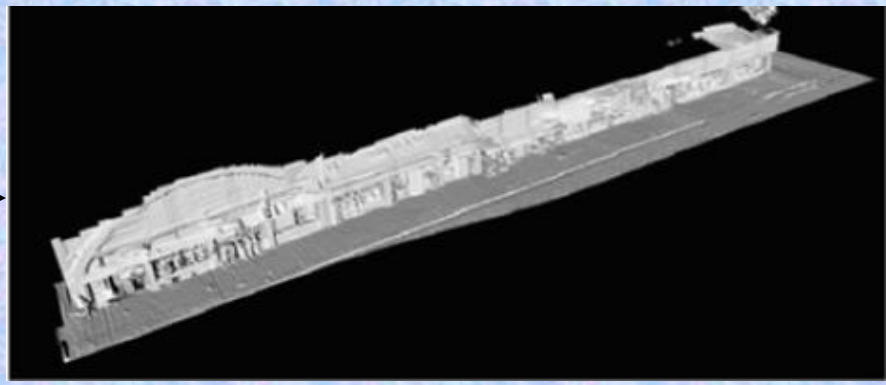
Raw vs. Improved

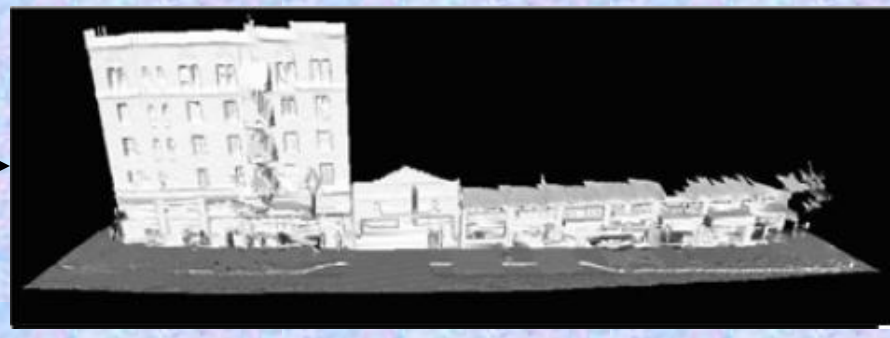
Visual Comparison of 73 City Block Fronts

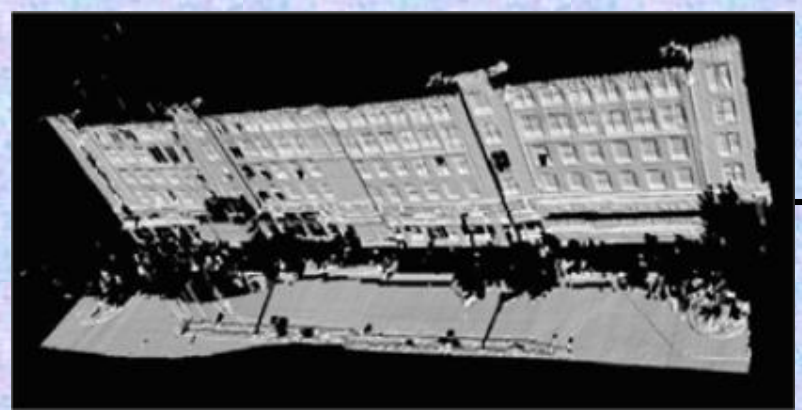
Significantly Better	35	48%
Better	17	23%
Same	15	21%
Worse	5	7%
Significantly Worse	1	1%
Total	73	100%

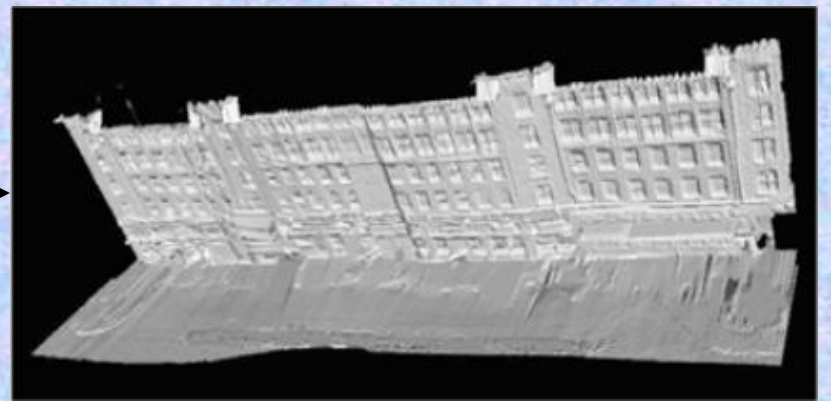
“Significantly Better” Examples



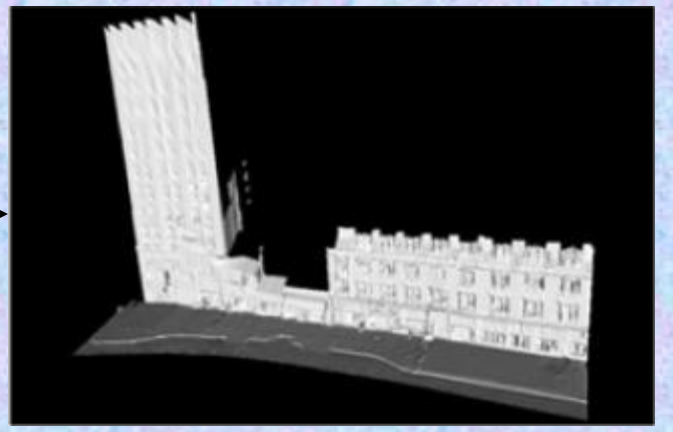


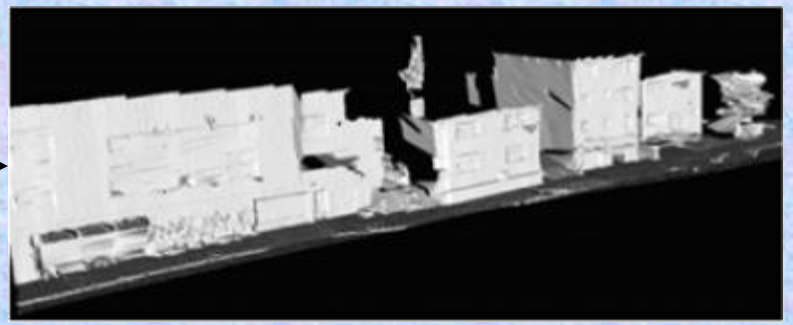




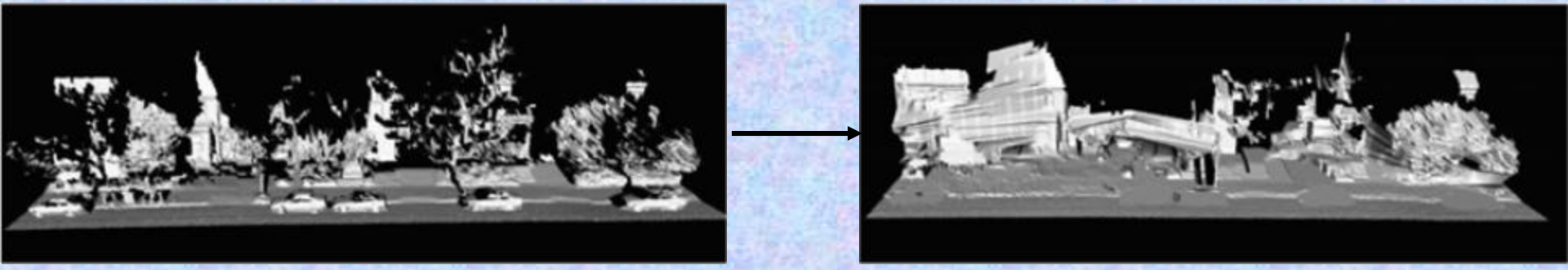


“Better” Examples

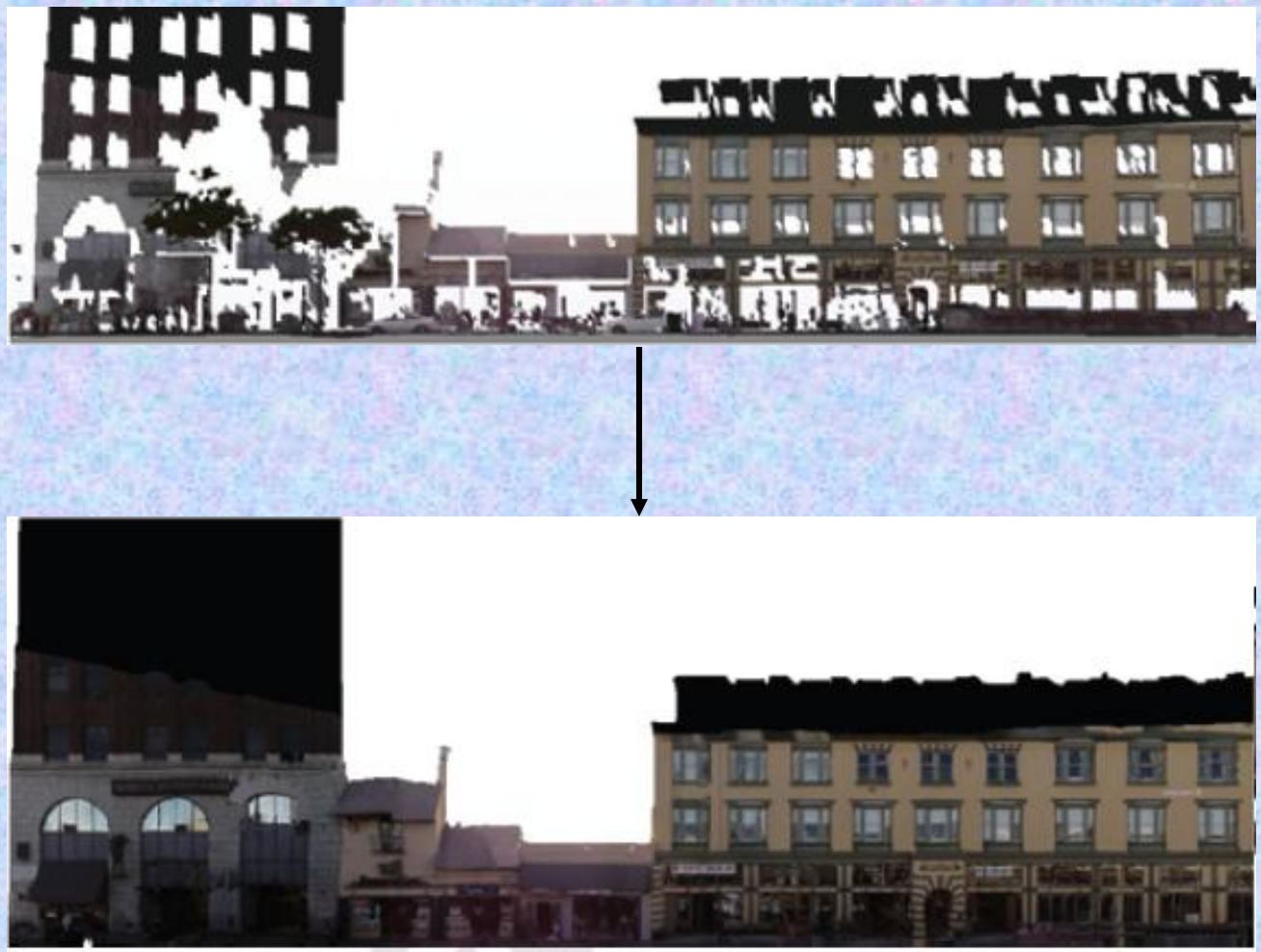




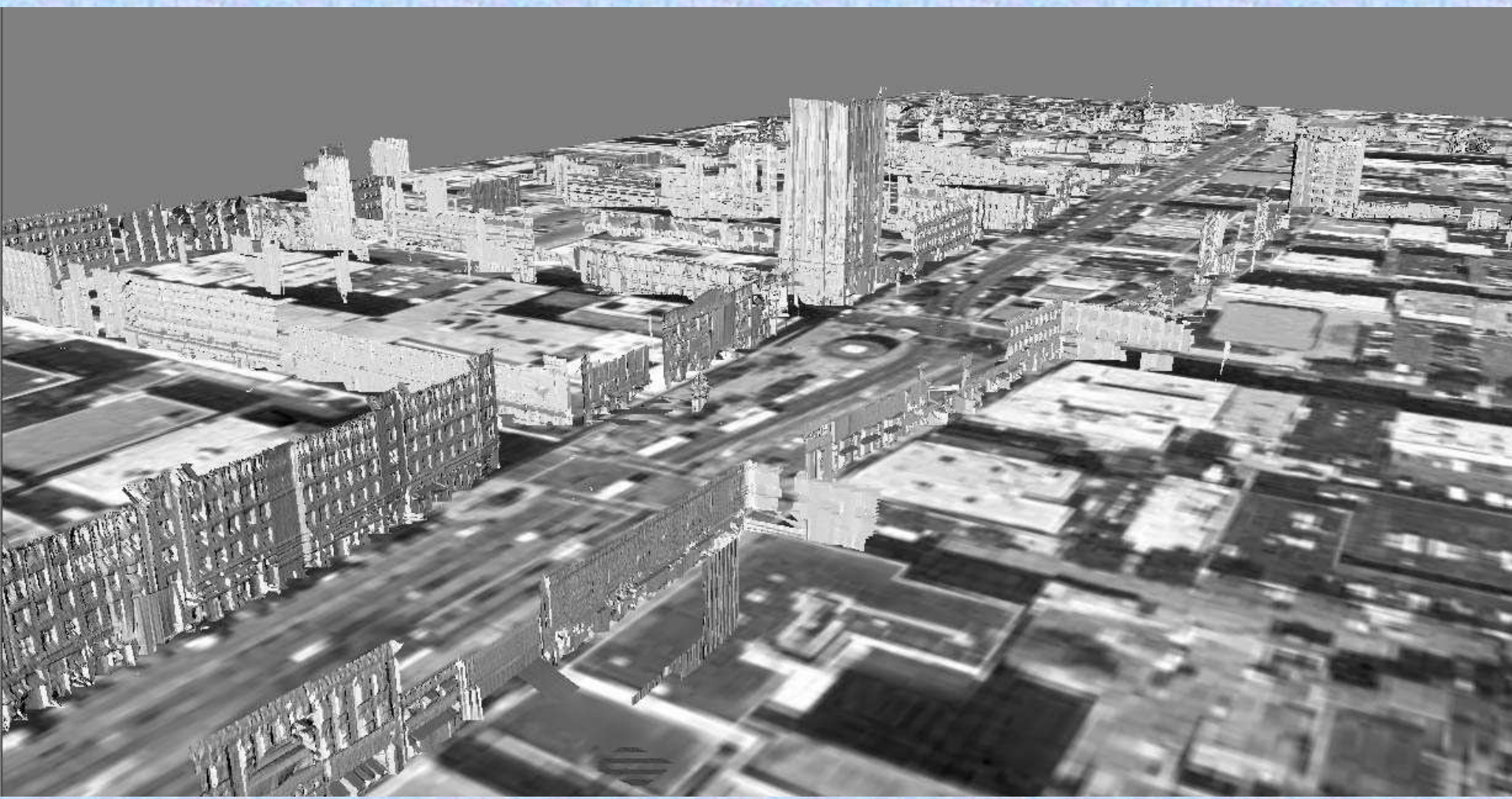
“Bad” Example



Downtown Berkeley



Downtown Berkeley



Downtown Berkeley

Downtown Berkeley