

Sharp 3D Reconstruction of Building Façades Using Range Data

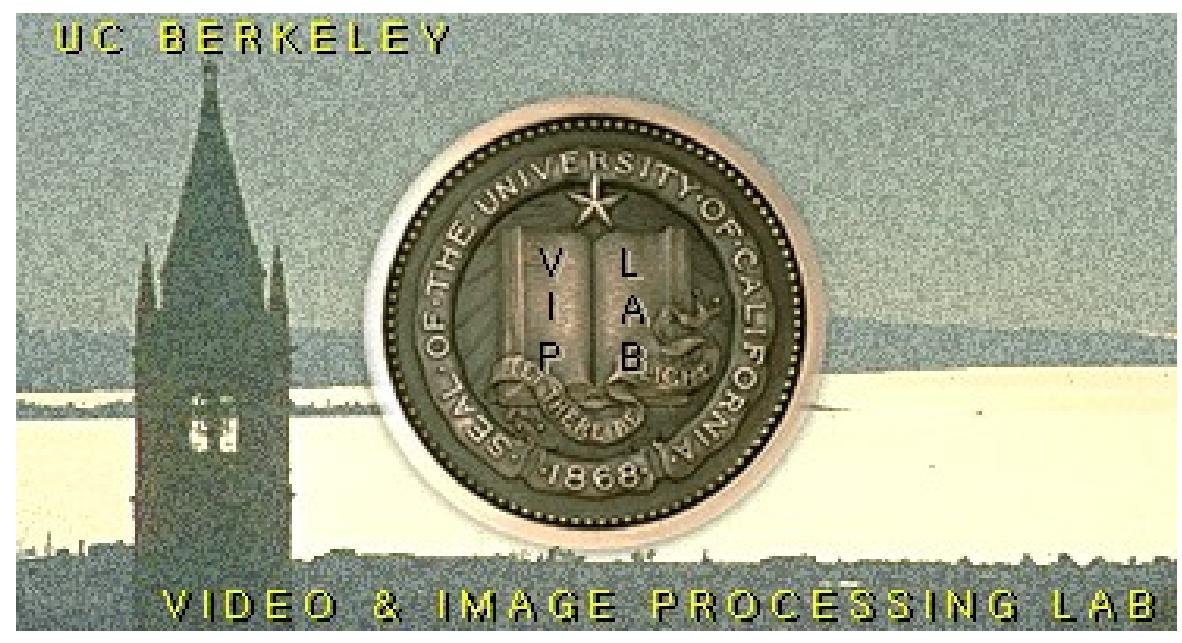
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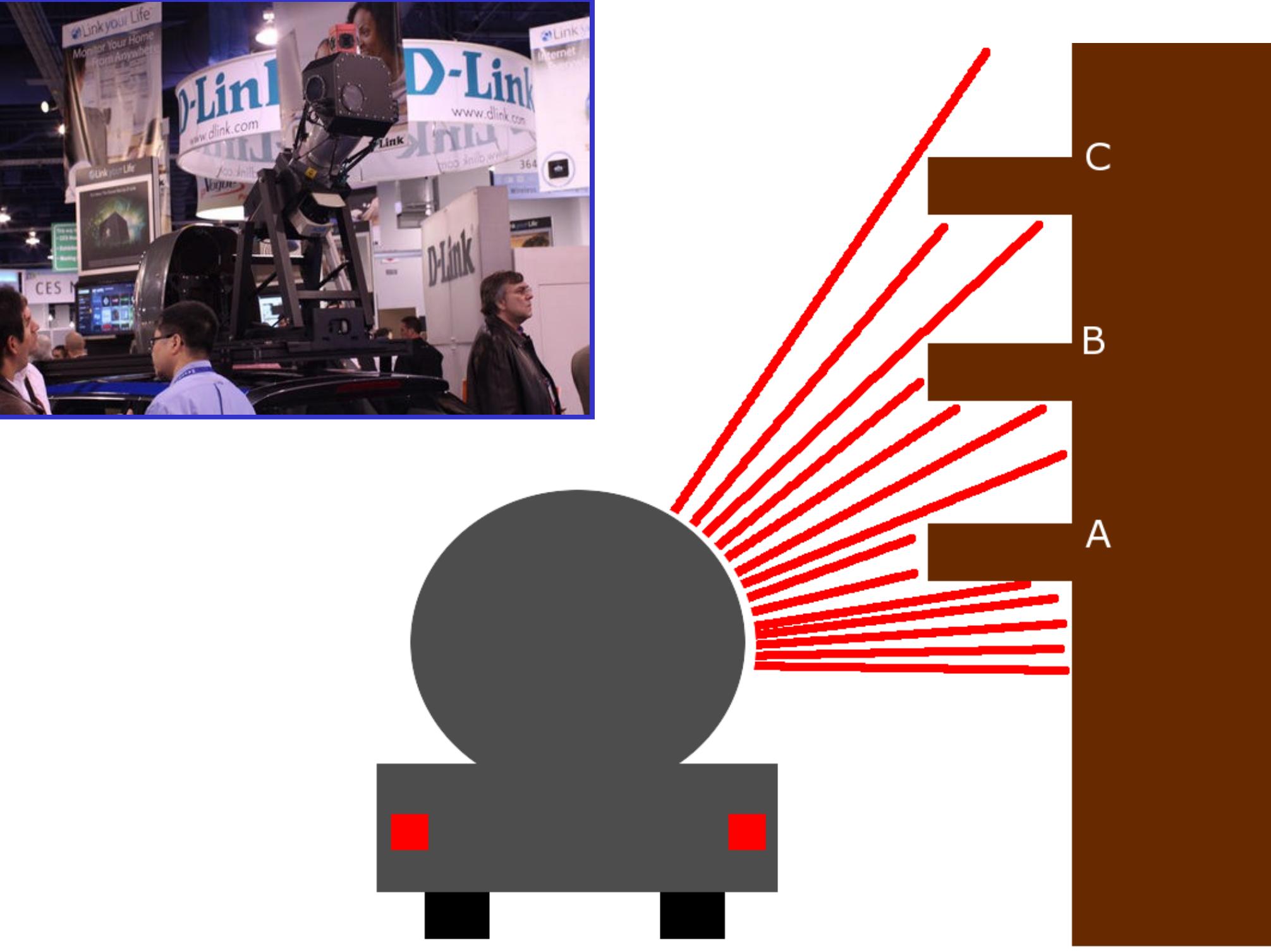
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Problem Statement

LiDAR and Imagery Collection



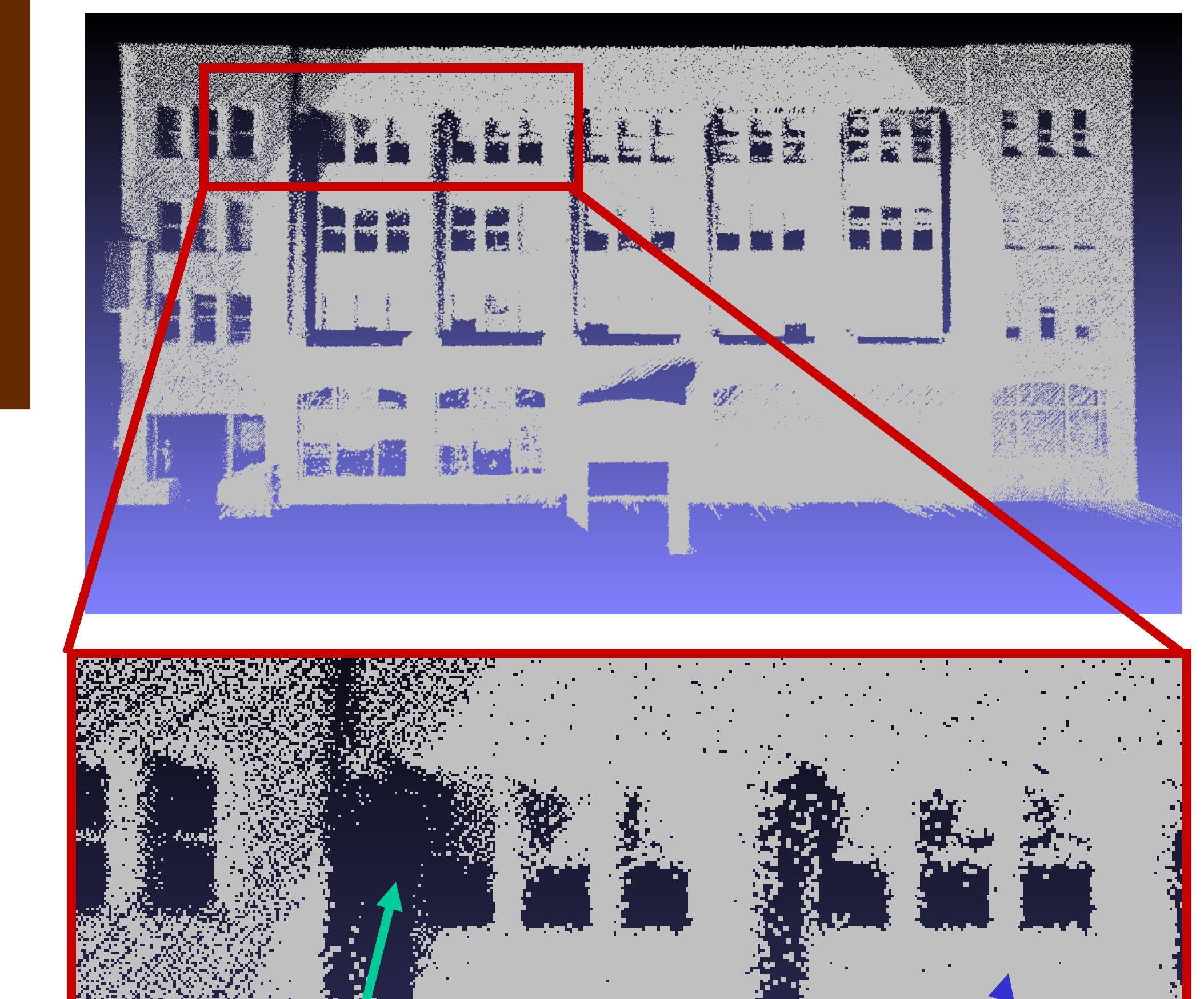
- Laser range scans and panoramic photography are captured from street level using an acquisition vehicle.
- The GPS and localization systems on the vehicle generate a world-coordinate point-cloud.
- Many areas in the point-cloud are occluded, requiring estimates of the underlying geometry.



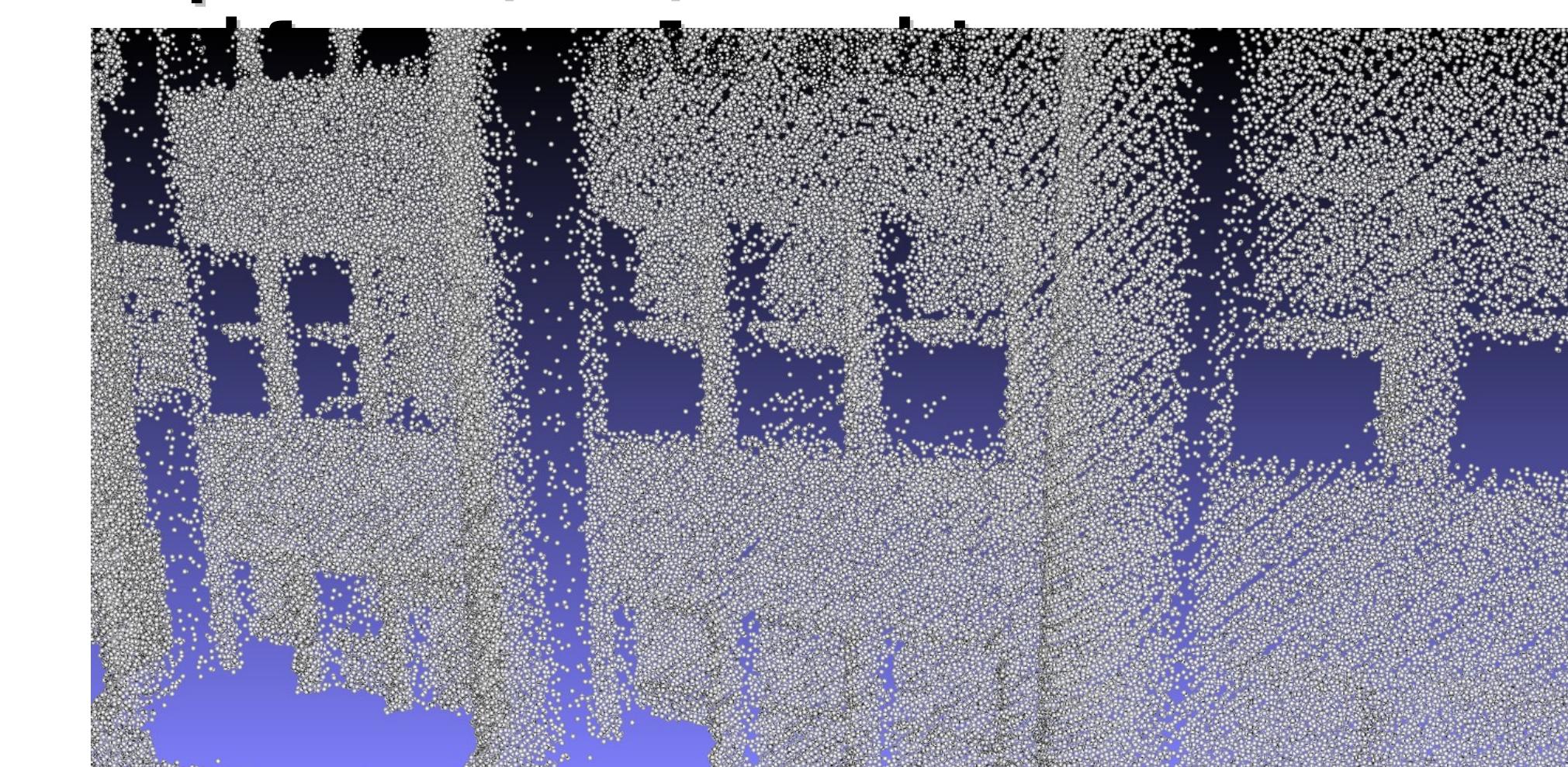
Point-cloud Sampling

Algorithm Overview

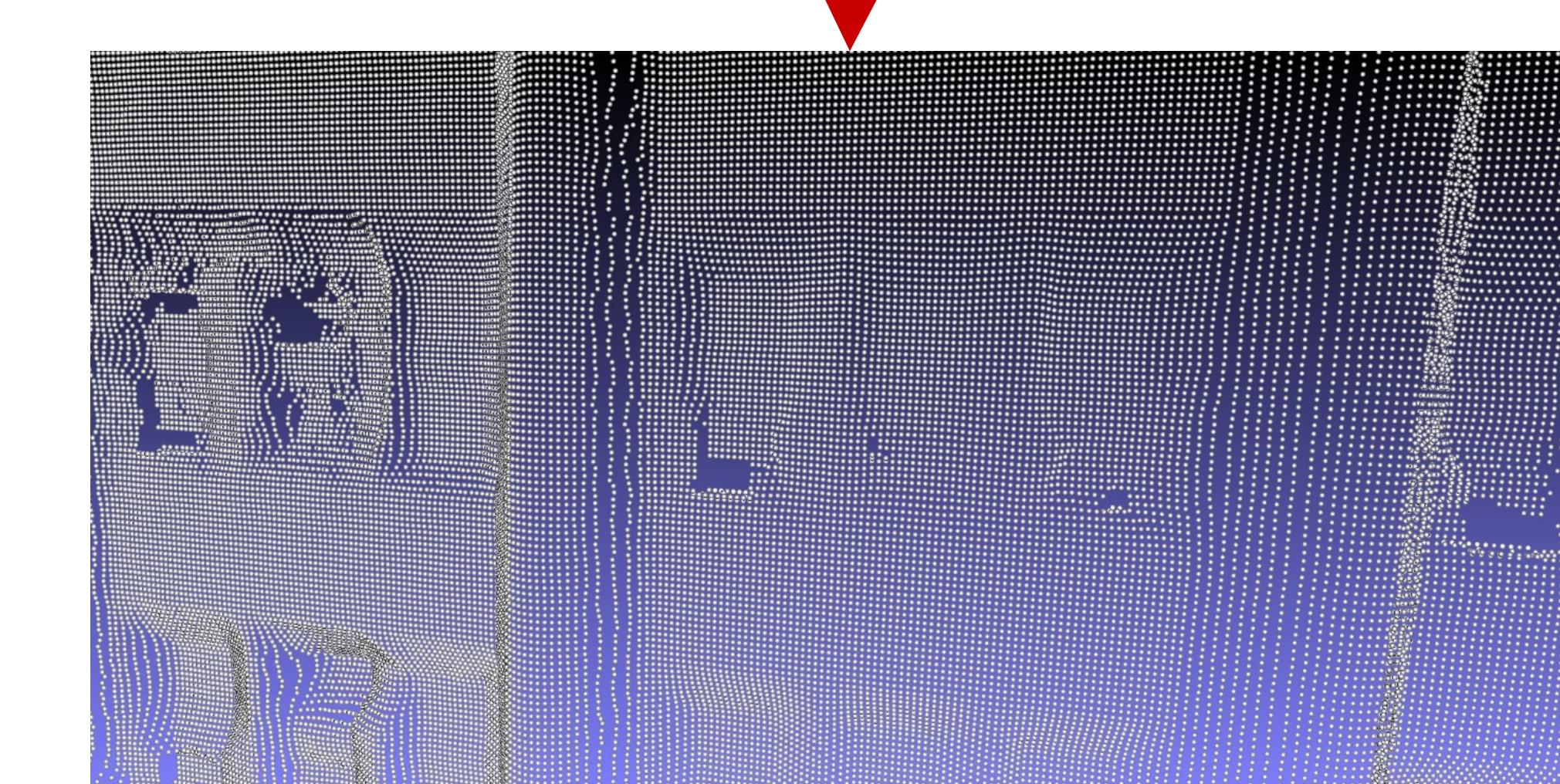
- Want to generate sharp 3D model of individual façades.
- Samples are noisy due to localization error of vehicle.
- Occlusions, windows, and acute scan angle cause high density of gaps in point-cloud.



Combination of areas of noisy oversampling with complete gaps in the point-cloud require the points to be interpolated. Moving Least-Squares (MLS) was used to create

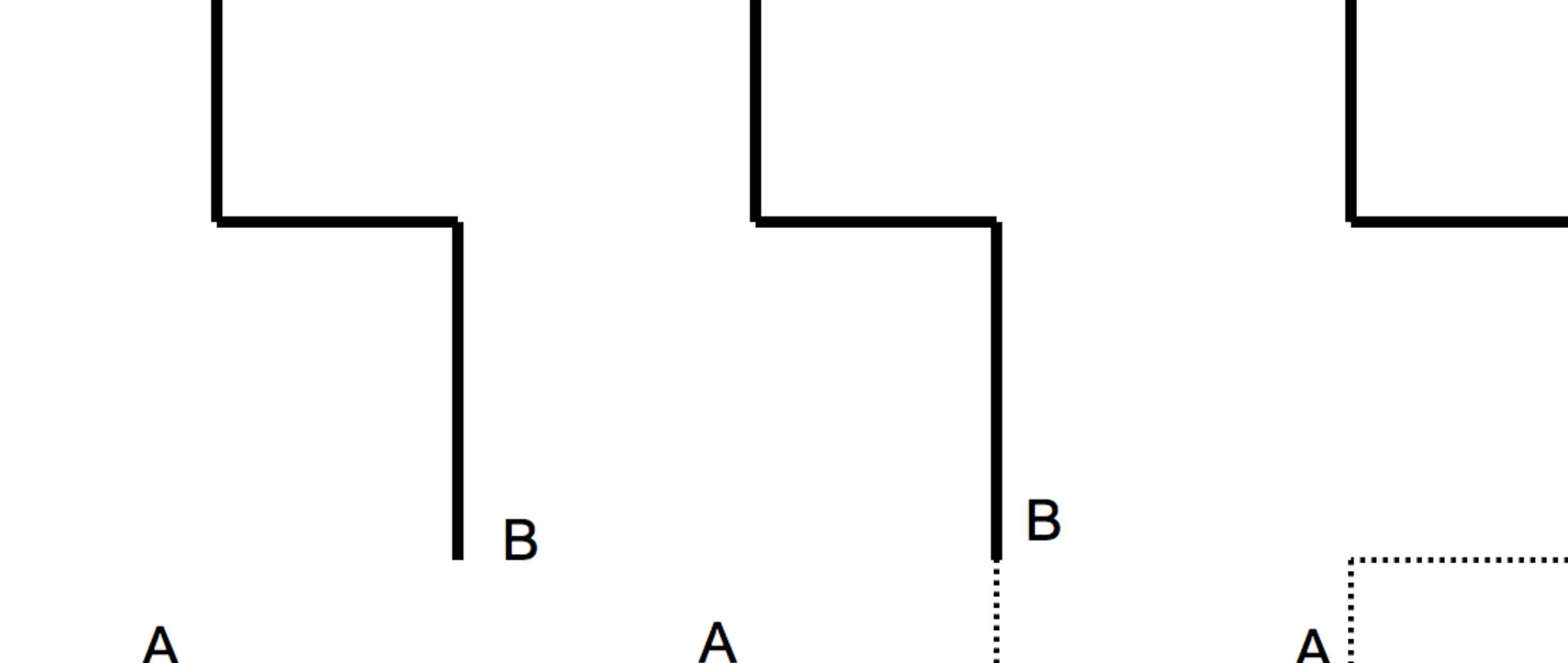


resample



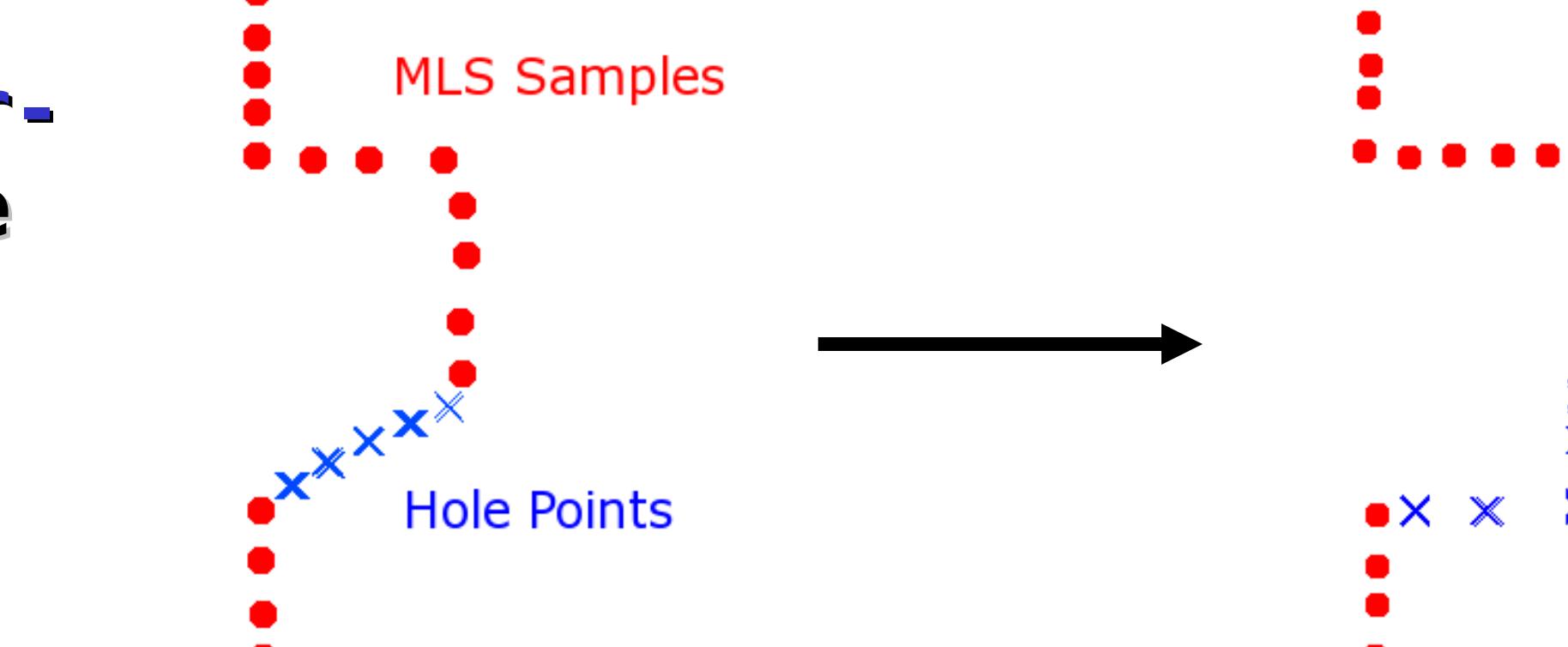
Hole Filling

Architecture Estimation Heuristic

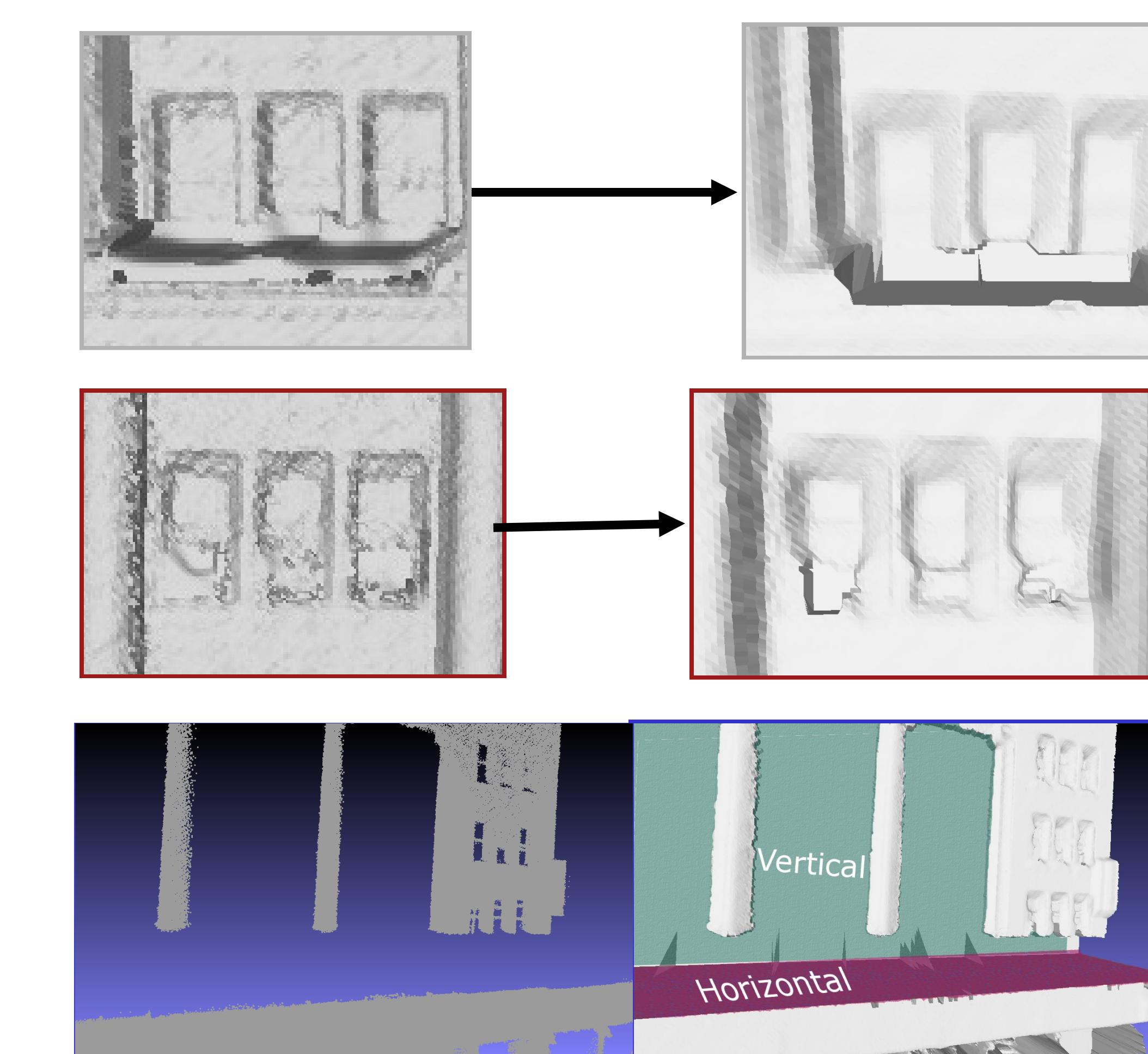


aligned gaps in the point-cloud are assumed to be caused by occlusions from the building architecture (e.g. window ledges, balconies, etc).

Holes are filled with axis-aligned planes, fitted to the maximum depth of each hole



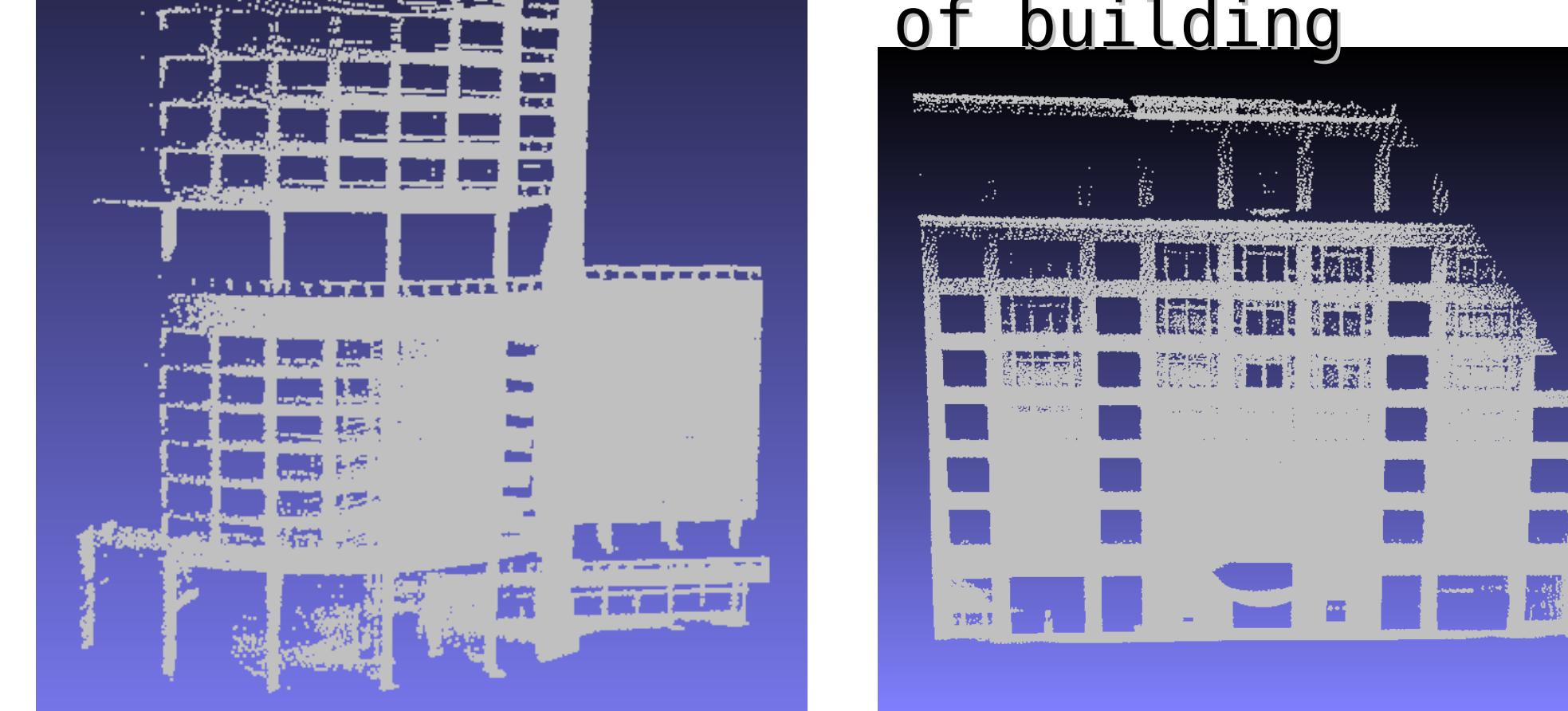
Examples:



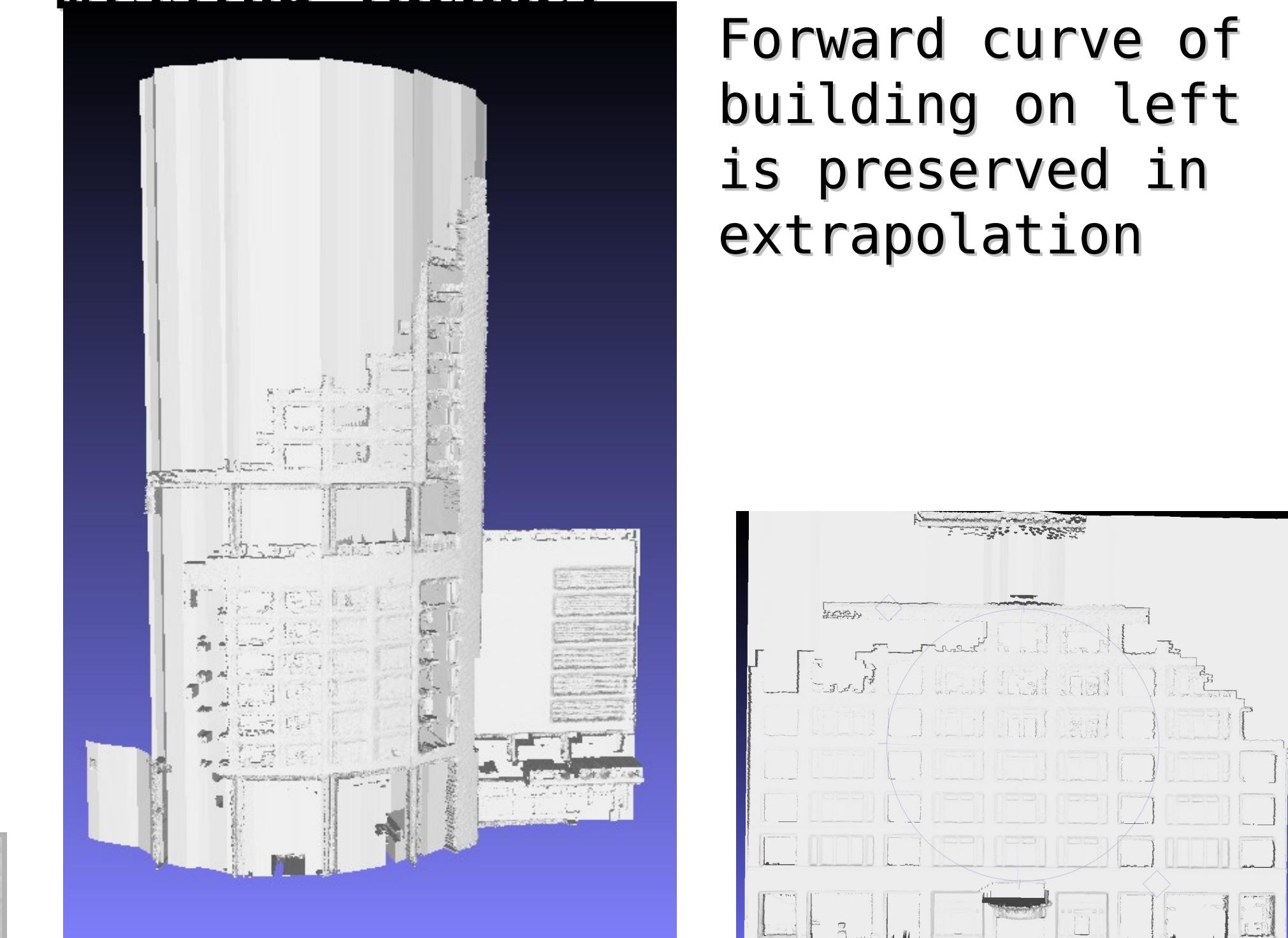
Building Extrapolation

Scans are conducted solely from ground-level, which results in minimal or no return for upper stories of buildings. General shape of façade must be extrapolated from existing model, given height desired.

Missing points can also be caused by incomplete scan of building



Mean depth of points below extrapolation area used to fit piece-wise linear approximation to missing facade.



Forward curve of building on left is preserved in extrapolation

Future work requires separation of each façade before processing. Processing all faces together will improve final quality.

No image processing performed to remove clutter from images, which causes texturing artifacts on 3D model geometry (e.g. trees, light-poles, etc).

Acknowledgements

All scans and imagery were collected and are owned by Navteq © 2011. This work was funded has been submitted to ICIP 2012.

Results

Comparison of model to reality

