Simple Panel System

Advanced Technology Integration

Will Randby – B.S. AE, M.S. AE (Nebraska)

Clayton Homes Industry Visit

7/18/2025

Presentation Timeline:

Introduction

ABC Project

Motivation and Focus

Current Advancements

Automation

Mixed Reality

Compute Power

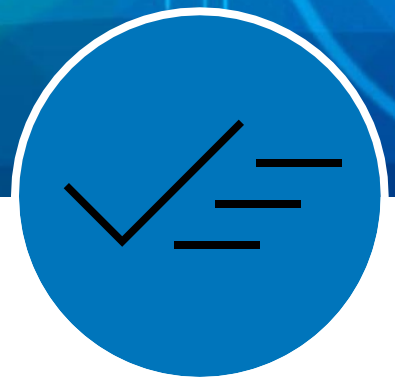
My Project

Technical Capabilities

Examples of Work

Source: Microsoft Office 365 Stock

Presentation Timeline:



Conclusion

Results

Applications

Future Uses

Virtual Building Simulation

3D Site mapping

Source: Microsoft Office 365 Stock

Goal

- Integrating energy efficiency solutions into construction practices for new buildings and retrofits
- Improving construction productivity and optimizing timeline

Advanced Building Construction Initiative

Source: NREL

The Problem

- 20 million housing units could benefit from deep energy retrofit
- Building type varies, custom fitting required

Simple Panel System

Advanced Wall and Mechanical Retrofit System

Source: NREL

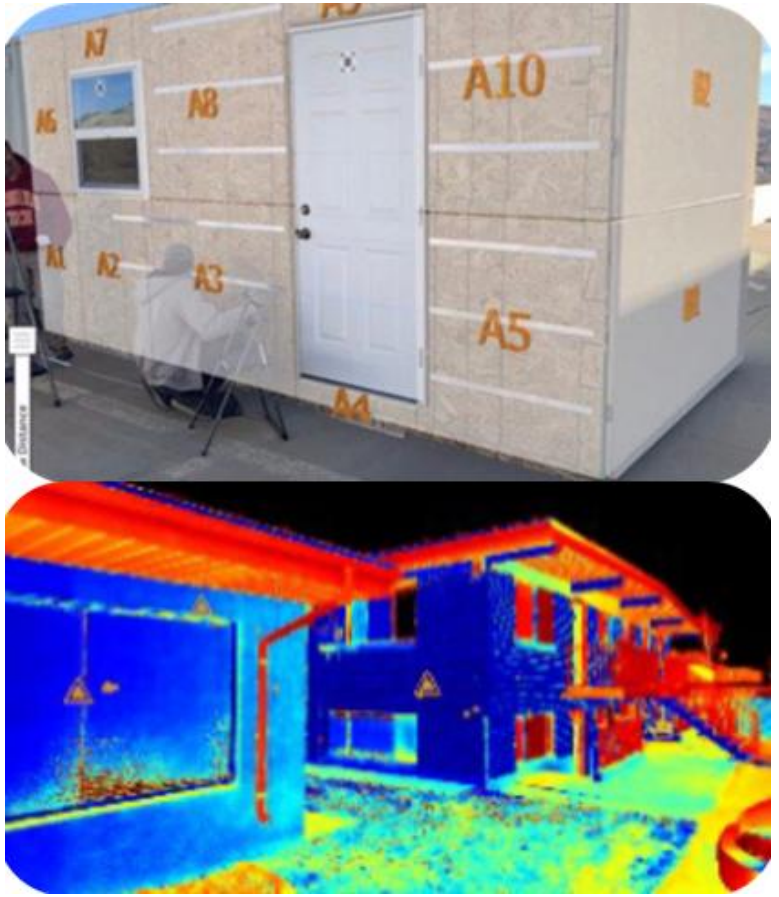
Simple Panel System

The Solution

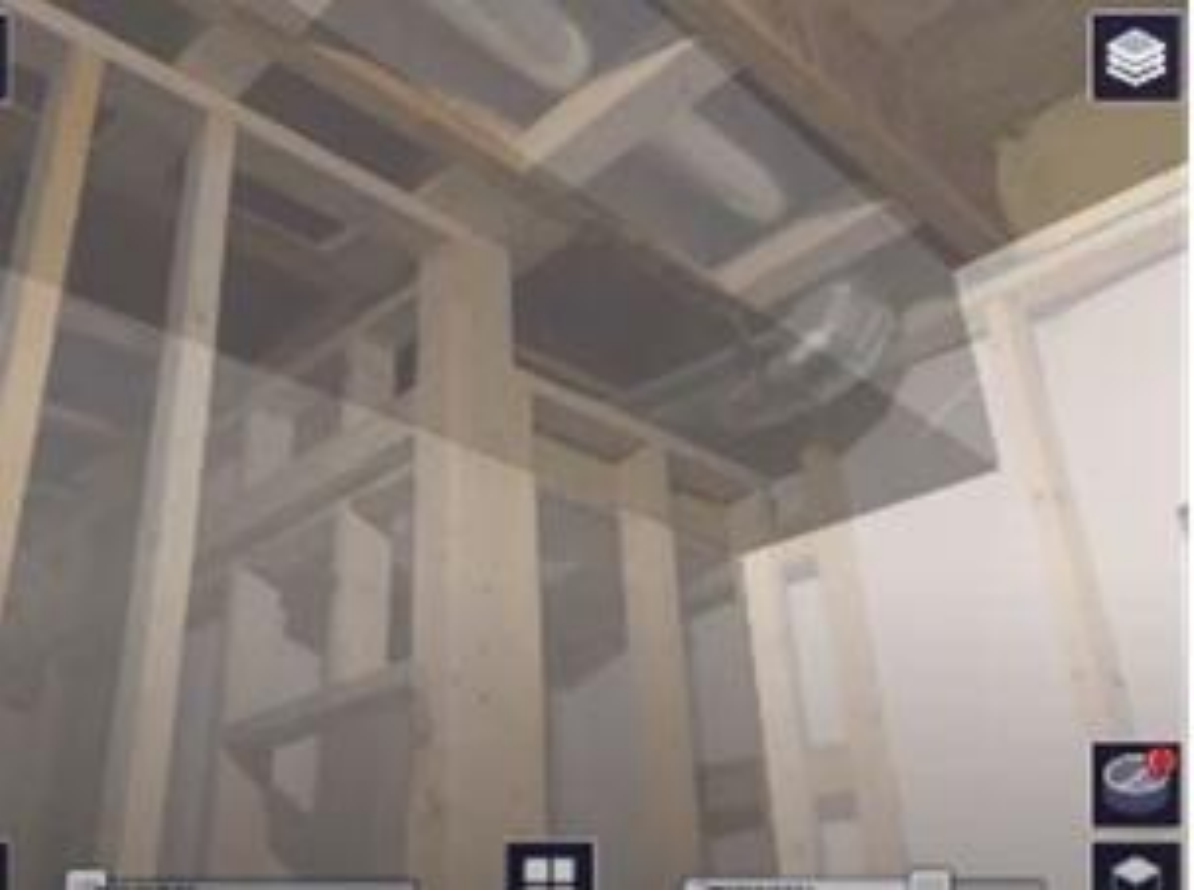
- Prefabricated construction
  - Elements rapidly designed and fabricated
- Rapid augmented reality addition
  - Scan-to-panelization workflow
  - Tailored to site conditions
- Prototyped in SLC multifamily apartments

Projections

- Utility bills lowered by ~20%
- Project cost reduction of 50%
- Construction time reduction of 50%



Source: NREL



Simple Panel System

Advanced Technology Integration

- Automated ductwork sizing and soffit design
- Building virtualization
  - Realtime adjustments
  - Whole building pre-retrofit modeling

Source: NREL

Simple Panel System

Advanced Technology Integration

- Mixed Reality
- 3D Scanning
  - Integration for building retrofits
  - Automation
    - Automated panel sizing
    - Attachment spacing

Source: NREL

Ground-based LIDAR System

+ Industry standard for accuracy (0.3mm at 20 meters)
+ Reliable in all lighting conditions
+ Fast data integration with workflow
- More laborious setup and operation

LIDAR – Pinpoint accuracy and established workflow

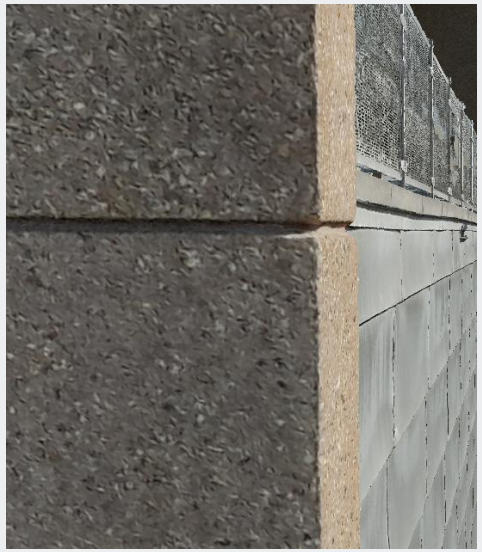
- Point cloud generated by Trimble FieldLink tablet imported to Trimble RealWorks software

Source: Trimble, NREL

Drone Photogrammetry

+ Little preparation required
+ Gather data at any height
+ Decreased occlusion
- Less precise measurements

Drone - Quicker and more flexible than LIDAR



- Model generated in 3DF Zephyr photogrammetry software

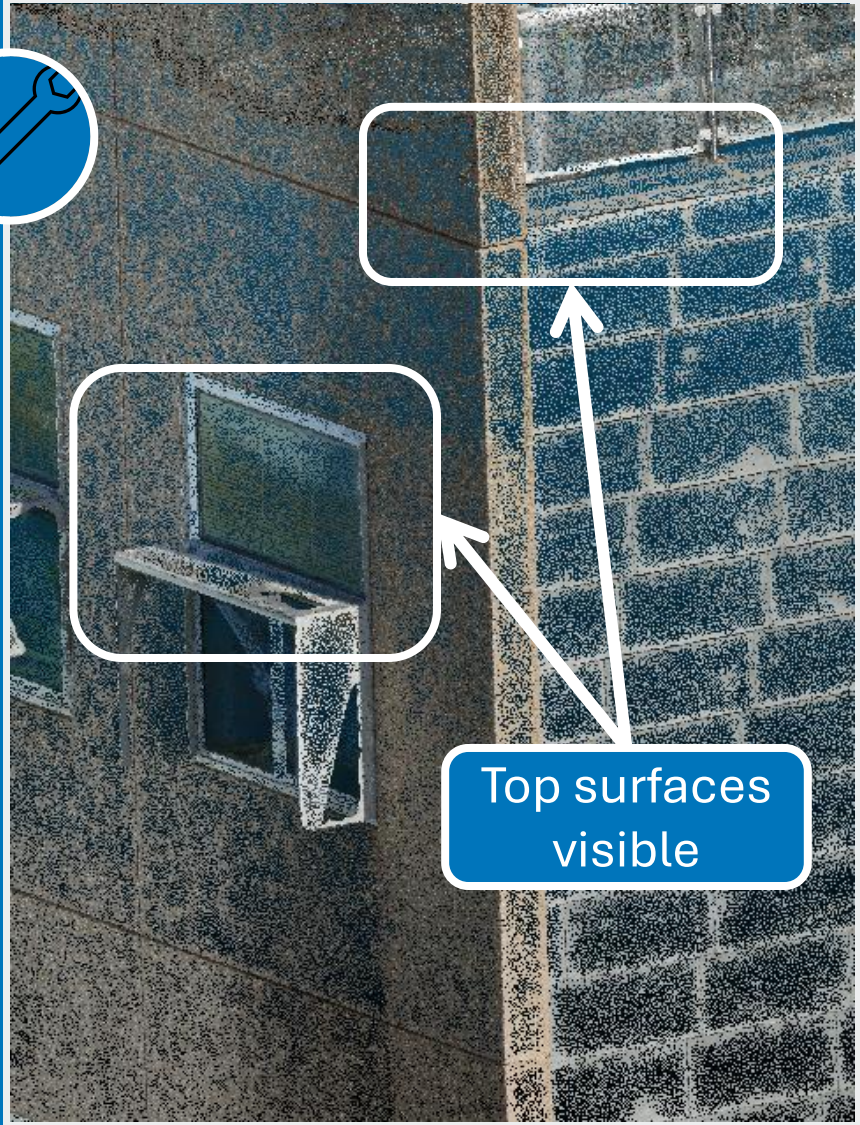
Source: Parrot, NREL

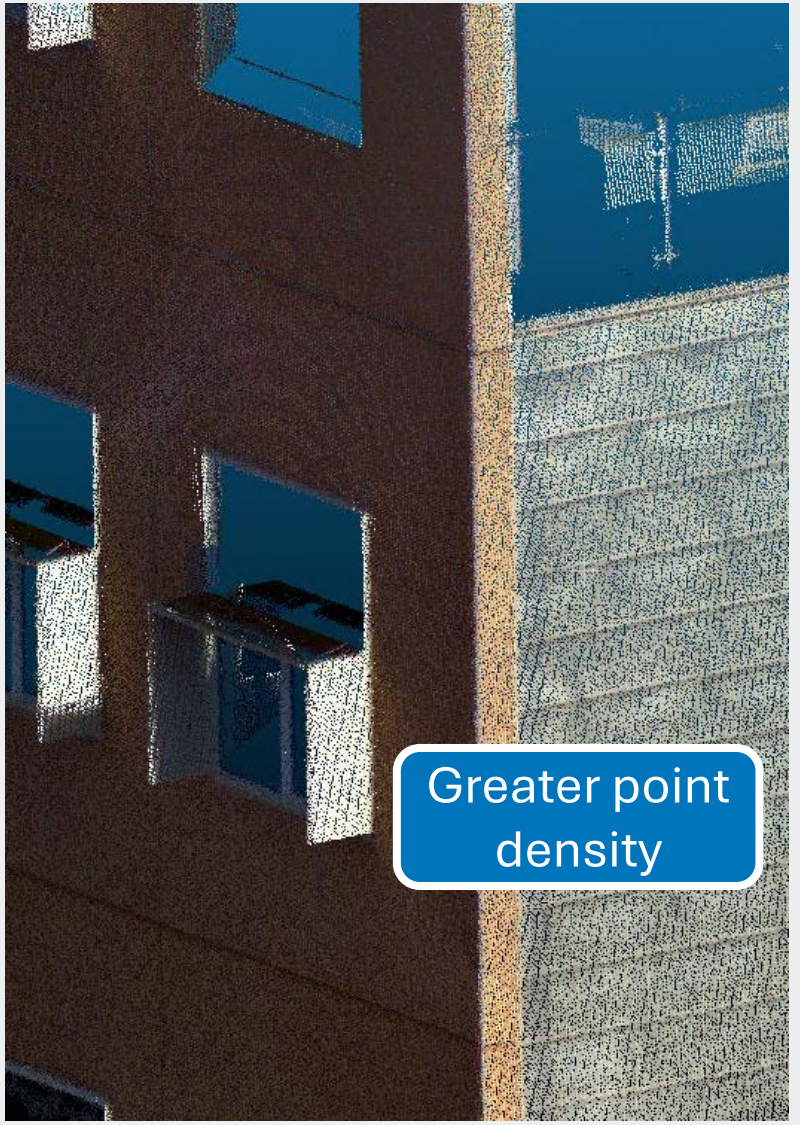
Drone Photogrammetry VS Ground-based LIDAR

Side-by-side in CloudCompare

- Drone scan shows points from all sides
  - Data from above
- LIDAR is more consistent across straight lines
  - Denser and more uniform point cloud

Side-by-side point cloud comparison:



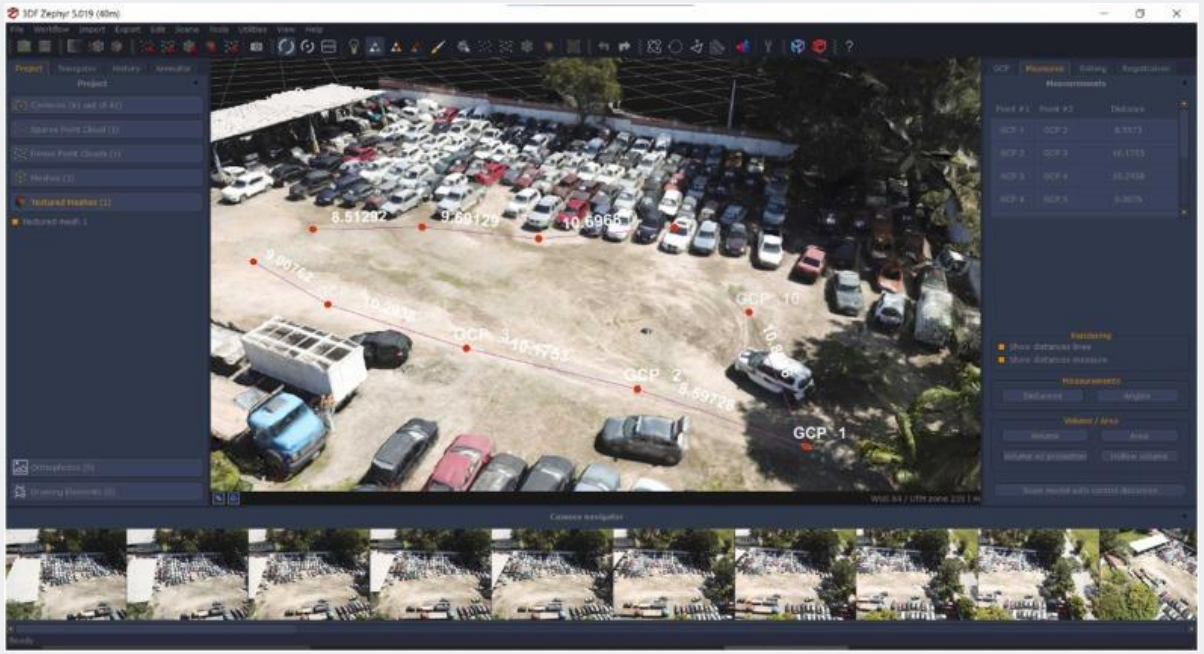


- Drone generated
- LIDAR generated

Source: NREL

Approach for comparison:

- Trimble X7 (RealWorks)



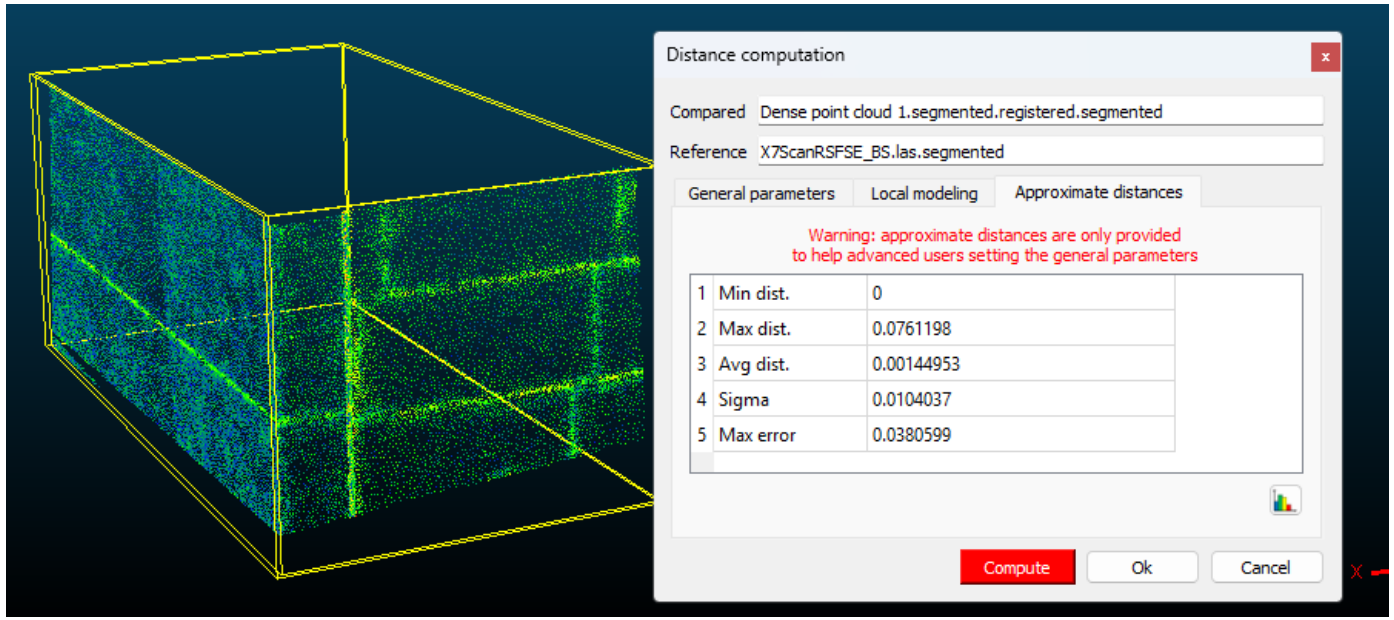
- Drone (3DF Zephyr)

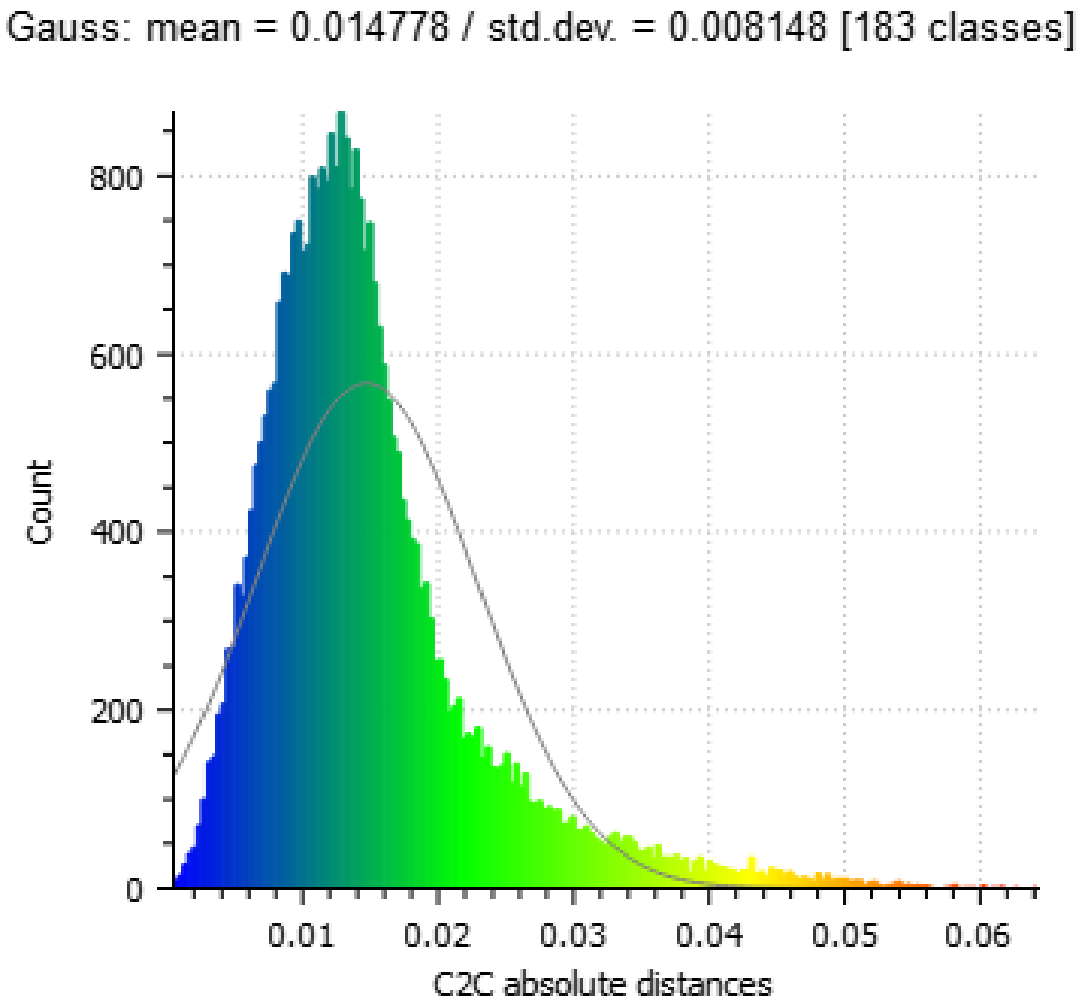
Drone Photogrammetry VS Ground-based LIDAR

- Comparisons made between set points to determine accuracy (ScienceDirect)
  - Science direct: Laser scanner and drone photogrammetry
    Rafael Rodrigues Cunha et. al.
    https://doi.org/10.1016/j.forsciint.2021.111100

Source: Science Direct

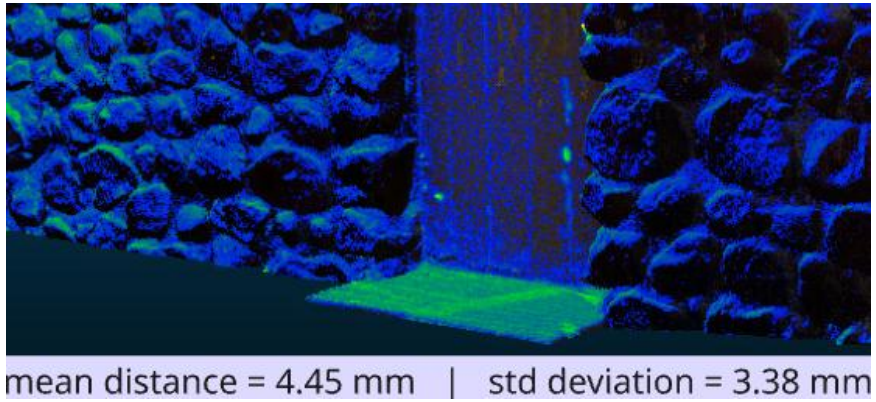
Example Calculations:



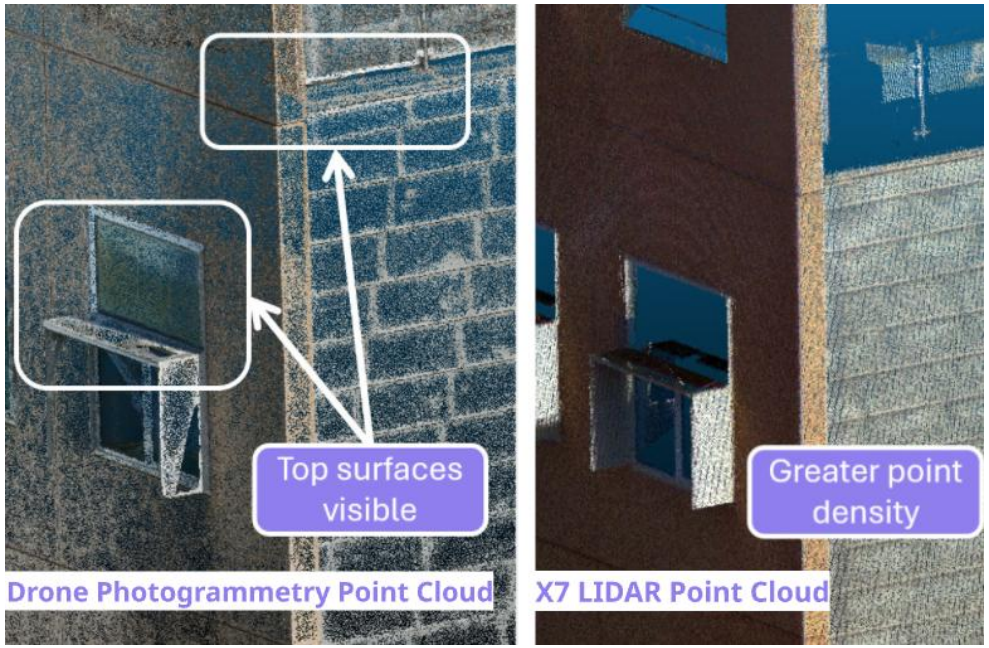


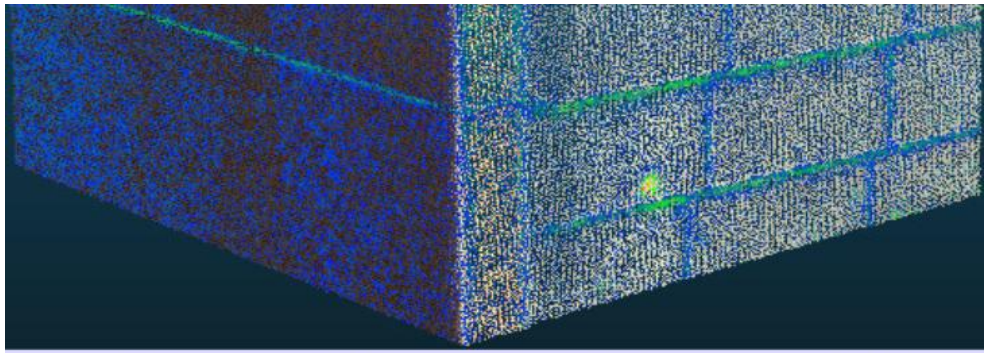
CloudCompare Results

3D Drone Photogrammetry:



mean distance = 4.45 mm | std deviation = 3.38 mm



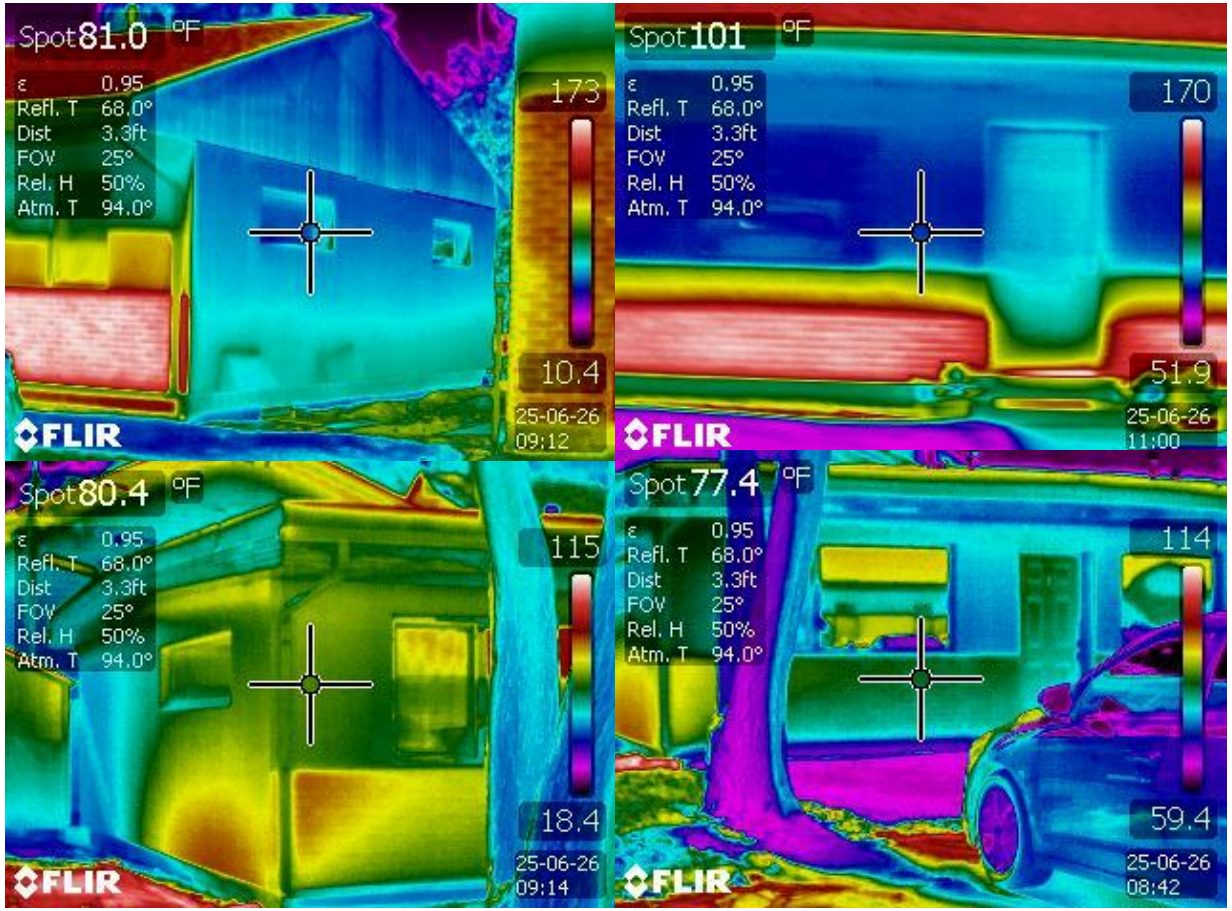


mean distance = 5.35 mm | std deviation = 2.98 mm

Future Work

Aerial thermal imaging

- Monitoring overall building performance
- Detecting heat leaks or defects in facades
- Measuring effectiveness of retrofits

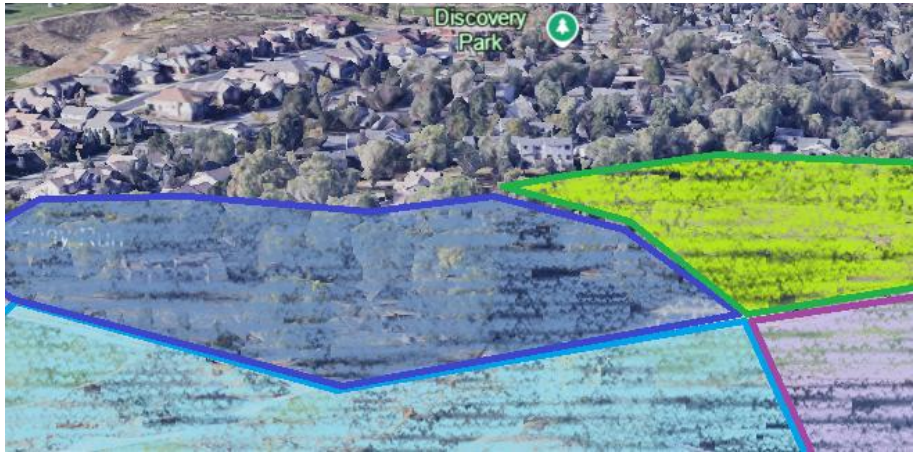


Source: NREL - SLC Site Visit

Future Work

Aerial mapping potential

- Construction, surveyors, agricultural, environmental
- Monitor land usage, scan property for damages
- Record build site before and during construction
  - Generate augmented reality models
  - Useful during build process and for future operations



Source: Google Earth, NREL

List of partners:

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NREL/PR-5500-95886

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