Three Dimensional Modeling with Photogrammetric Information Point Clouds

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FDOT Photogrammetry & Remote Sensing

Purpose for this Presentation

- Introduce the emerging Photogrammetric Information Point Cloud as a source for accurate 3D Modeling.
- Realization in the direction to which 3D modeling will progress with technology and “big data”.
- Offer interest in 3D modeling methodologies that may carry back to your workplace.

Why 3D Modeling

- 3-Dimensional Models synchronize with GPS controlled machinery, day and night, allowing projects to quicken, enhance quality and could improve safety.
- 3D modeling and terra-forming software can be utilized in determining cut & fill or grading results before breaking ground.
- Remote Sensing platforms such as aerial and terrestrial systems can expedite the production of 3D models derived from LiDAR and Imaging Sensors.

How 3D Models for engineering purposes are derived

- Traditional Surveying methods
- Traditional Photogrammetry
- LiDAR Acquisition of Point Clouds
- Photogrammetric Semi-Global Matching Point Clouds

What is a Photogrammetric Information Point Cloud

- The Photogrammetric Point Cloud is the newest methodology for deriving high resolution Information data.
- In traditional photogrammetry and LiDAR any given point in a final data set has an XYZ coordinate.
- Now with the advent of the “Information Cloud” any given point could have an XYZ, time stamp, R,G,B, NIR or an NDVI value.
- This is made possible by “SGM” or Semi-Global-Matching.

- NDVI - The Normalized Difference Vegetation Index is a simple graphical indicator that can assess the health of vegetation.

What is “SGM” semi-global matching

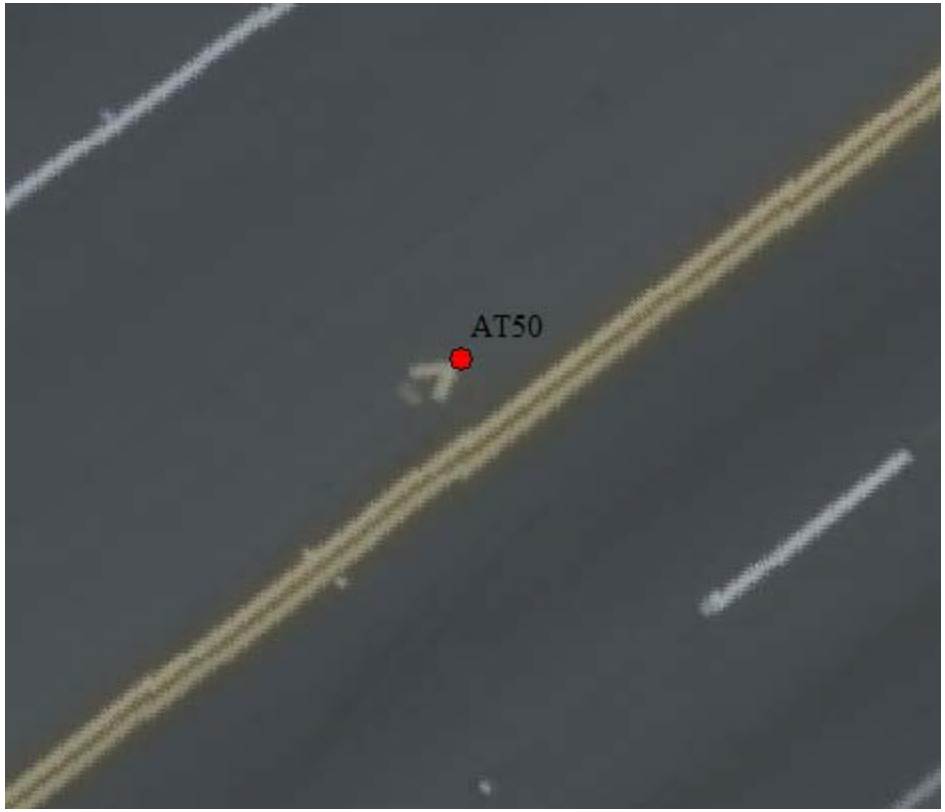
- Semi-Global Matching or SGM is the latest technology developed to further enhance the advantages of a new generation of Digital Camera Systems such as Large Digital Frame and Push-Broom Scanners.
- Utilizing aero triangulated with digital frame imagery, a high density surface model is generated for use in orthophoto and map production. Capturing imagery and surface models during the same flight with the same sensor ensures that image features and image geometry perfectly match with the Digital Surface Model (DSM).
- The resulting pixel level correlation generated point cloud is photogrammetrically accurate to the same level as the mapping. The point density achieved (300 points/m^2 at a 5cm GSD) is far greater than airborne LiDAR (8 to 10 points/m^2).
- In some systems, “SGM” point clouds are beginning to return accuracy levels achieved by a mobile LiDAR in open hard surfaces.
- The SGM process minimizes the need for additional LiDAR flights in the use of the production of orthophotos and various other products.

What makes SGM a viable Point Cloud

- Algorithm for computing every pixel.
- Achieves very dense image matching on a pixel basis rather than on windows.
- Exploits multi-ray matching across images.

What is the accuracy

- Evaluate Survey Control in the Information Cloud.



What are the advantages

- Having geometric and radiometric information fused into a data set will allows users to identify individual objects, structures and regions much easier than when only the geometry is provided. By combining remote sensing with traditional photogrammetry a new product can now be offered that has added value compared to LiDAR products.
- In the last decade airborne LiDAR has established itself as a key technology to capture high resolution digital surface models and over the same time period the demand for higher accuracy and higher resolution 3D model has increased.
- LiDAR is a natural choice to fulfill this demand but the additional acquisition costs may often prohibit its use solely for orthophoto production.

What are the Disadvantages

- The main disadvantage is the inability to penetrate foliage
- Currently unable to function adequately with scanned film imagery.
- Require emerging digital imaging systems to take full advantage of the SGM algorithm.

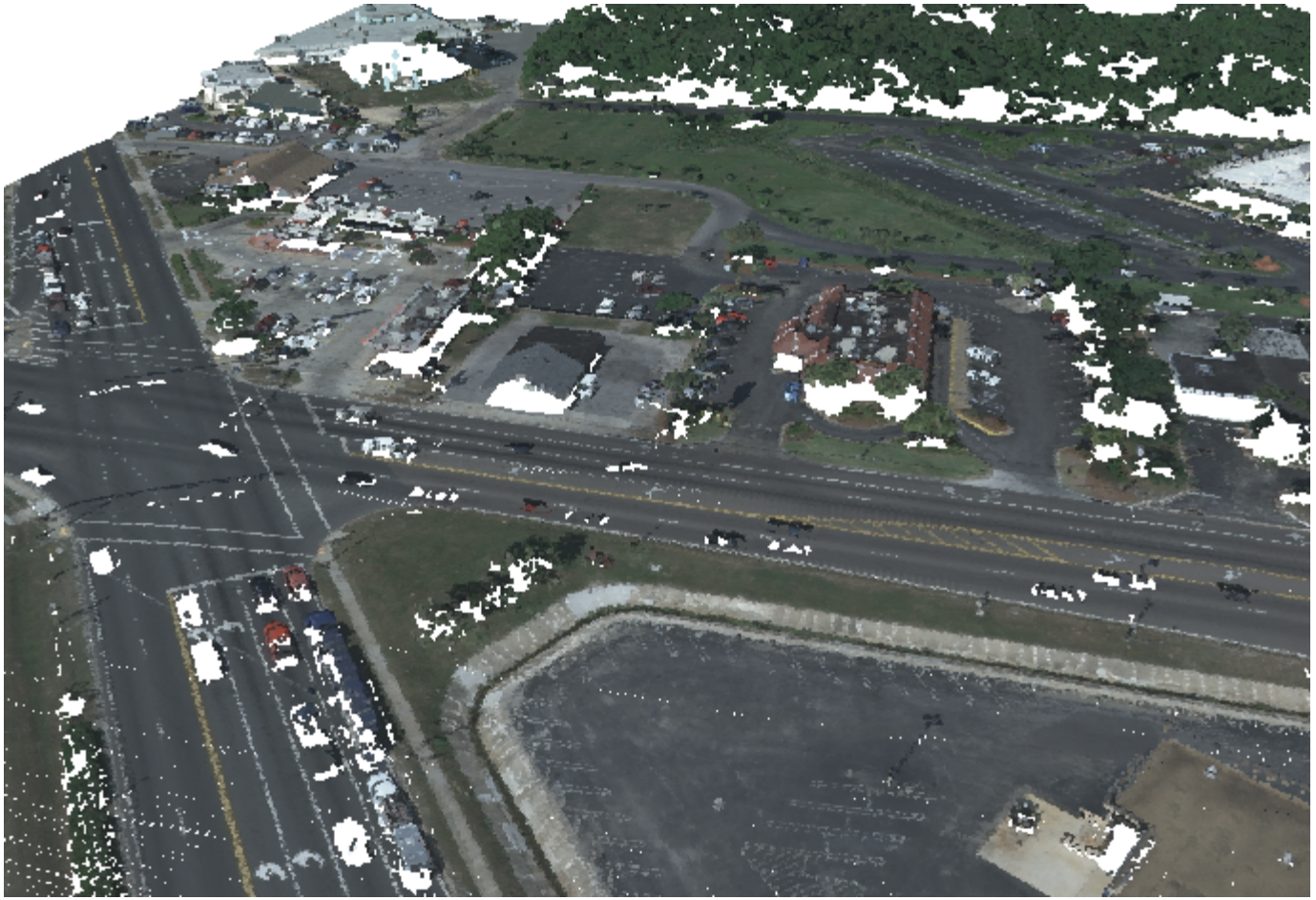
Conclusion

- Emerging technologies are Introducing more efficient, expedient and accurate results to the Job Site and 3D modeling is setting the precedence for a smarter way to work.
- Photogrammetric Information Clouds are just another tool in the tool box and combined with other sources such as LiDAR can only increase the success rate.

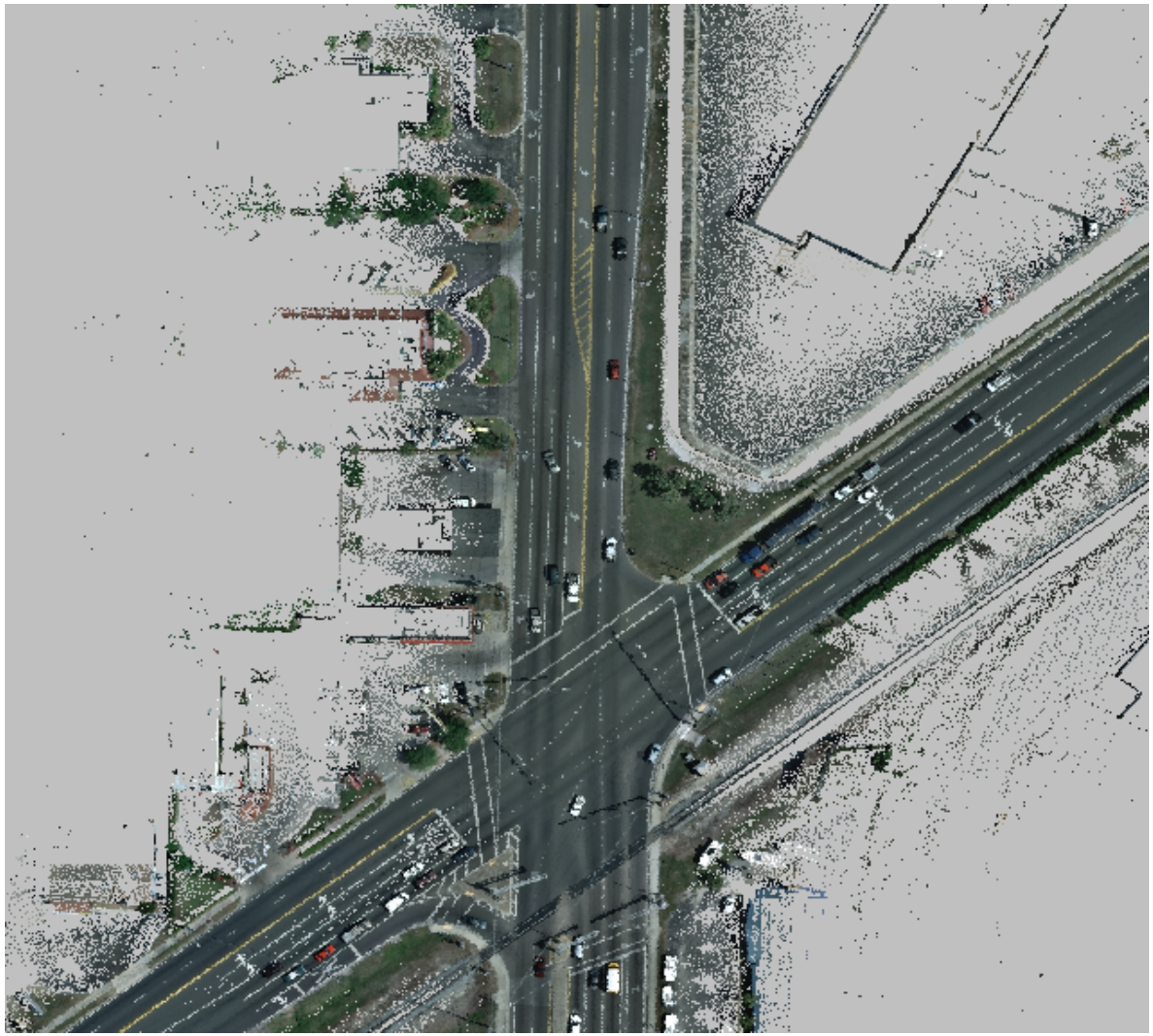
Global Mapper Point Cloud Demonstration

- The SGM Point Cloud

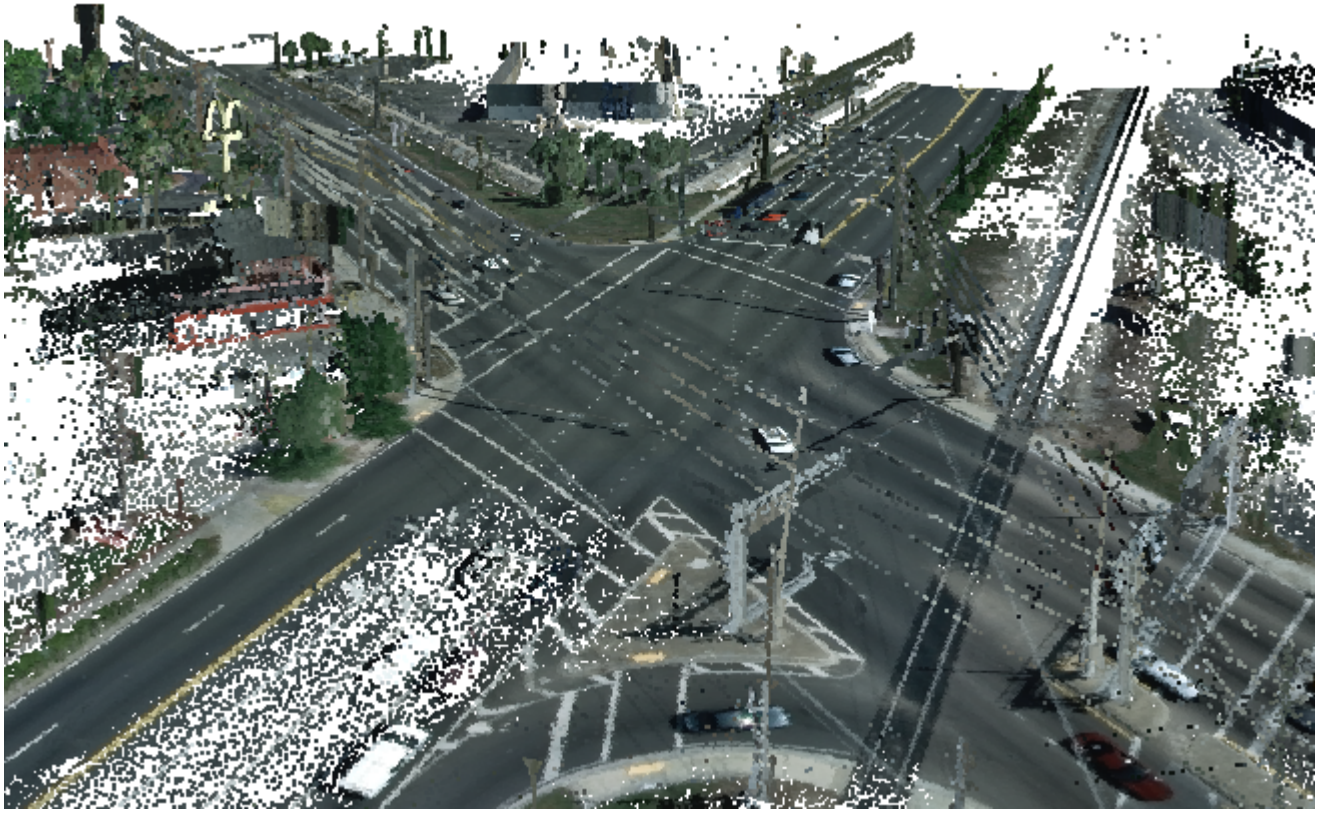
SGM 3D View



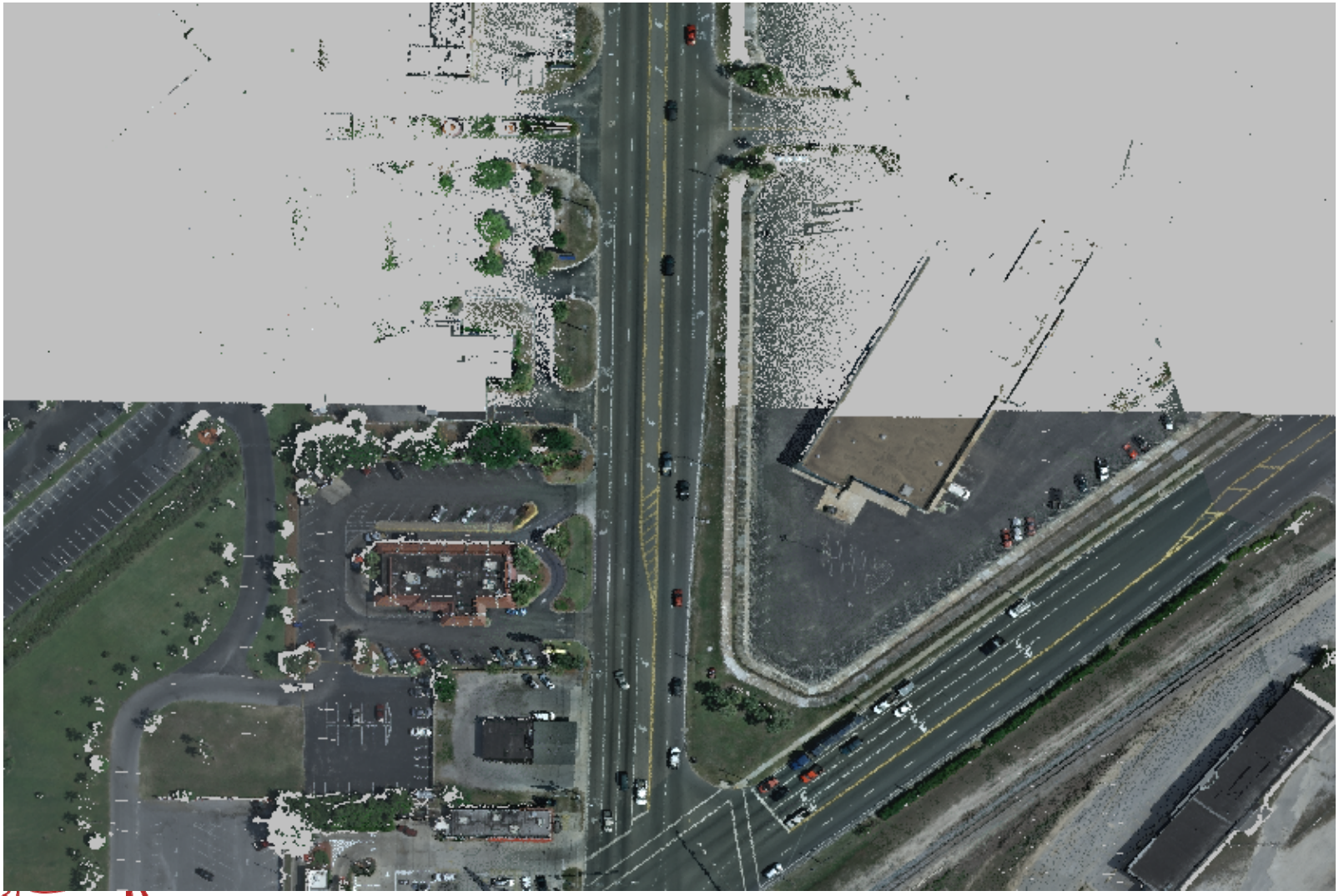
Mobile LiDAR colorized by ortho



Mobile LiDAR 3D View



SGM & Mobile LiDAR merged



SGM & Mobile LiDAR merged 3D View