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Non-Intrusive Site Scanning with LIDAR (Light Radar) System

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NON-INTRUSIVE SITE SCANNING WITH LIDAR (LIGHT RADAR) SYSTEM

THE NEED

Recent studies by the Construction Industry Institute have indicated that for a typical $100 million construction project, between $500,000 and $1million is spent on keeping track of where things are on the site and monitoring the status of construction activity. This indicates that the timely knowledge of project status -- where things are, what has been done, what needs to be done -- is the single most important issue facing construction managers today. But the measurement is required in a construction quicker and cheaper than current practice and should be done without impacting existing operations. Actual lidar scan: This image provides an example of the dense clutter to be expected at an everyday construction site. With research managed by National Institute of Standards and Technology, this can be done by developing techniques for real-time assessment and documentation in terms of 3D as-built models of the constructions such as as-is condition of hazardous environment where human intervention would be impossible.

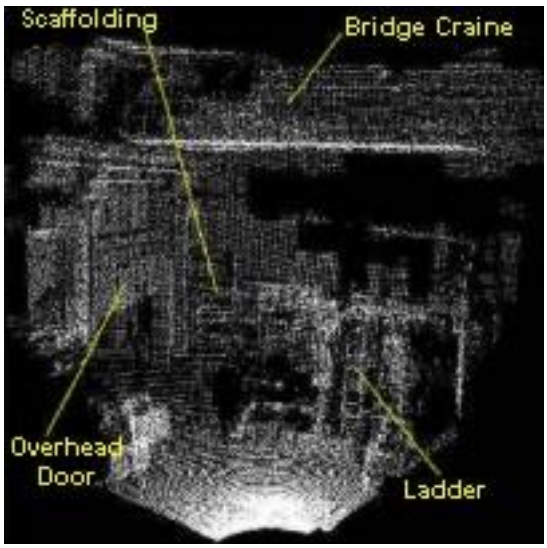

FIGURE 1 ACTUAL LIDAR SCAN: THIS IMAGE PROVIDES AN EXAMPLE OF THE DENSE CLUTTER TO BE EXPECTED AT AN EVERYDAY CONSTRUCTION SITE

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THE TECHNOLOGY

Tracking the state of components at construction sites that are of an amorphous nature such as terrain is currently done by surveying. This can be costly and time-consuming. The emergence of scanning lasers has made real-time updates and earthwork calculations of the construction site a viable technique. The gathering of data is non-intrusive and will not impede the construction progress. The scanned data are imported using the import module. A file is then opened containing x, y, and z data values and stored as a 2-vector (x, y position) location and a scalar value (z). Modules construct, regrid and rubbersheet are the primary modules. Construct defines the mesh size and origin. Regrid maps the scattered points onto a grid.

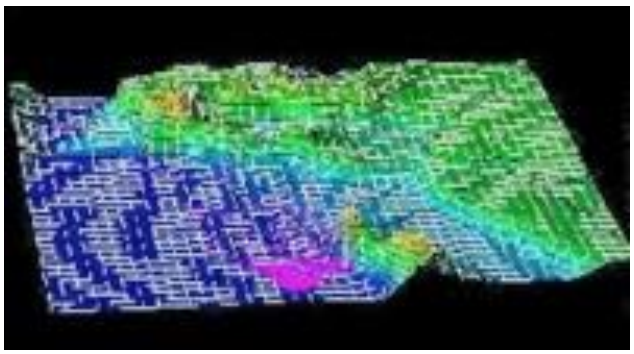

FIGURE 2 THE VOLUME ARE COMPUTED BY MULTIPLYING THE PROJECTED ARE OF THE TRIANGLE BY THE AVERAGE OF THE HEIGHT OF THE PRISM AND THEN SUMMING UP THE VOLUMES FOR ALL THE PRISMS

The module allows for the specification of the number of nearest points to the grid point to be used to calculate the average data value for that grid point. A radius may also be defined within which the nearest neighbors can be found. The Module rubbersheet deforms the surface based on the data values (z-values) of the surface.

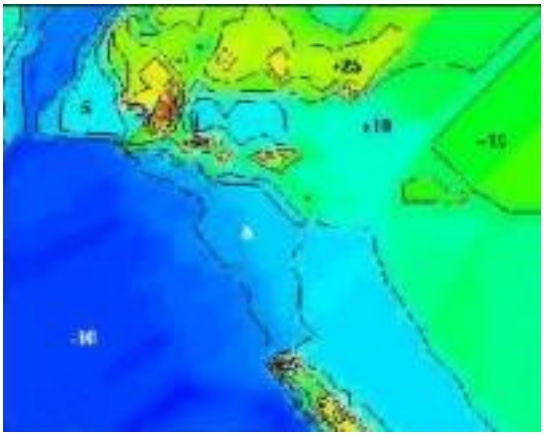

FIGURE 3 AUTOMATICALLY GENERATED CUT/FILL MAP CREATED BY OPERATING ON THE 3D TERRIAN MODEL (NEGARIVE NUMBERS REPRESENT FILL REQUIREMENTS WHILE POSITIVE CONTOURS REPRESENT CUT REQUIREMENTS)

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BENEFITS

- Real-time assessment of construction progress;
- Remote monitoring of construction by design engineers, project manager, architect, etc.;
- Early detection of error in construction procedure resulting in cost savings;
- Obtaining as-built models of structure;
- Improved project planning and documentation.

STATUS

In the past several months, NIST has shown that the scanning technology is a viable technique. Calculation of cut/fill requirements can be done semi-automatically and 3D graphical representations of the terrain can be done using commercially available software. Currently, registration of point clouds is done manually. Automatic registration will be further developed in the upcoming years.

BARRIERS

- Single location scan not sufficient to capture the scene fully. Scans obtained from several locations are needed to eliminate occluded objects and features. Automatic registration and a mobile platform have to be developed.
- Object recognition from point cloud data is needed so that the object may be removed if necessary or replaced with a more accurate and basic/simple 3D object.
- Real-time update and accurate scanning lasers (millimeter level accuracy) are not currently achievable based on current scanning technology.
- Resistance by construction industry to utilize "new" technology until it has been proven to be reliable and results in cost-savings.

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REVIEWERS

Peer reviewed as an emerging construction technology

DISCLAIMER

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