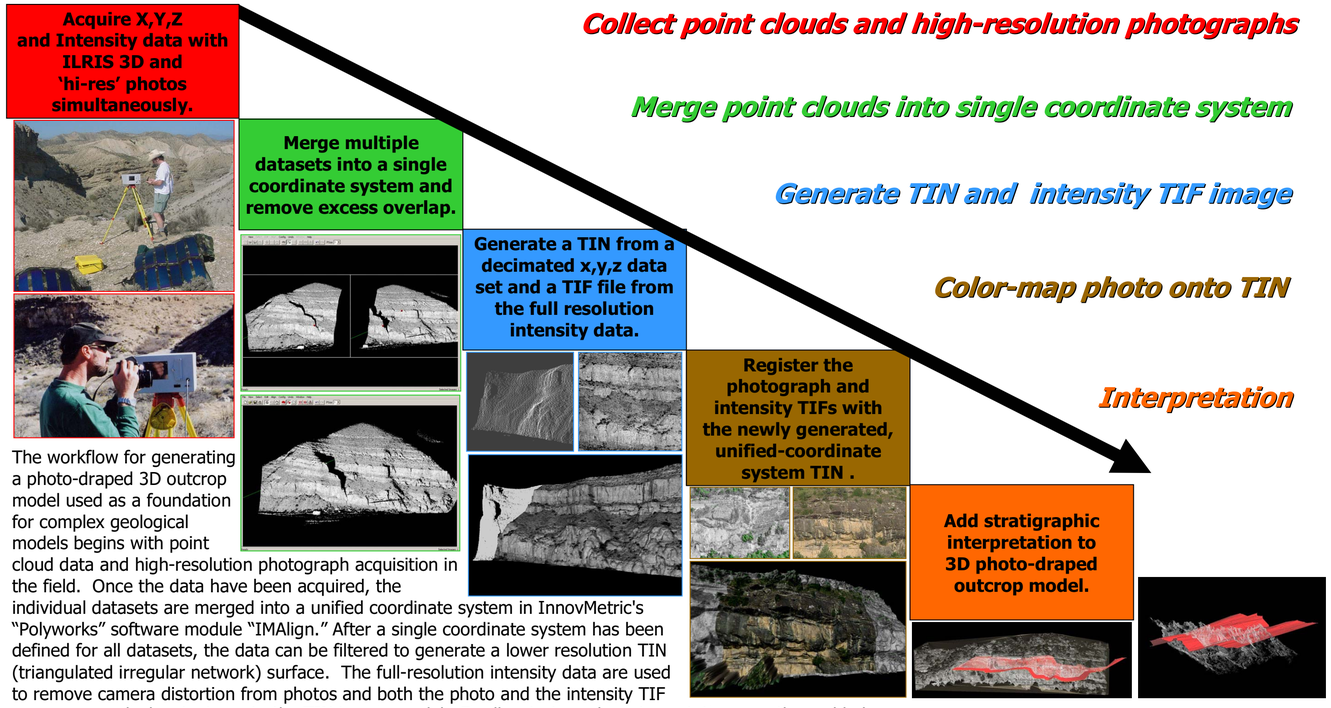
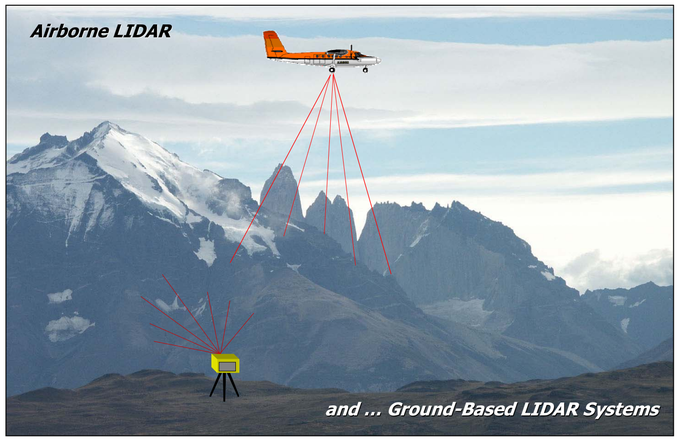
3D Outcrop to 3D Model Concept & Workflow

Click here to go to second poster.



The workflow for generating a photo-draped 3D outcrop model used as a foundation for complex geological models begins with point cloud data and high-resolution photograph acquisition in the field. Once the data have been acquired, the individual datasets are merged into a unified coordinate system in InnovMetric's "Polyworks" software module "IMAlign." After a single coordinate system has been defined for all datasets, the data can be filtered to generate a lower resolution TIN (triangulated irregular network) surface. The full-resolution intensity data are used to remove camera distortion from photos and both the photo and the intensity TIF image are applied as textures to the TIN terrain model. Finally, stratigraphic interpretations are then added.

LIDAR at The University of Texas at Austin



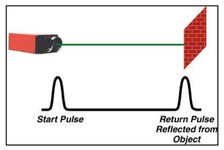
This thing called LIDAR:

LIDAR is an acronym that describes a method of determining position of a target relative to some arbitrary reference point. LIDAR stands for Light Detection and Ranging. It was originally used by atmospheric and planetary geoscientists in the 1960s to image bodies of galactic matter and atmospheric plumes.

LIDAR
- Light Detection and Ranging

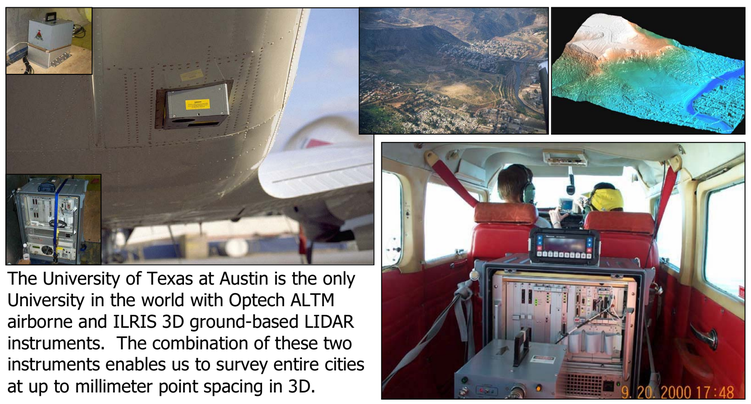
RADAR
- Radio Detection and Ranging

SONAR
- Sound Navigation and Ranging



LIDAR can be compared to other remote sensing techniques such as SONAR and RADAR which also determine the position of distant targets from a known point.

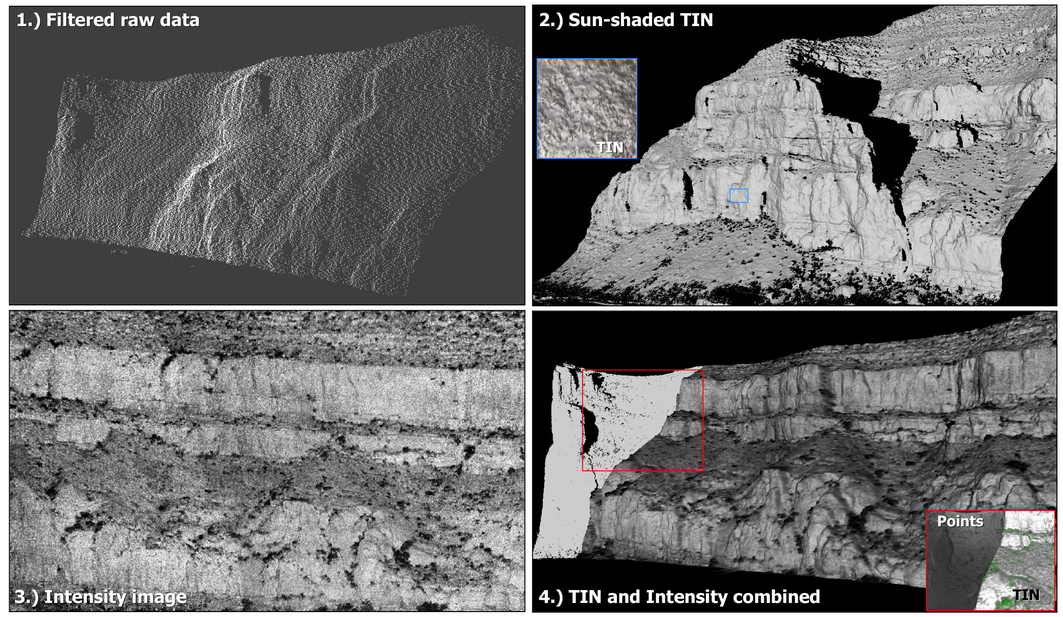
Airborne LIDAR Instrument:



The University of Texas at Austin is the only University in the world with Optech ALTM airborne and ILRIS 3D ground-based LIDAR instruments. The combination of these two instruments enables us to survey entire cities at up to millimeter point spacing in 3D.

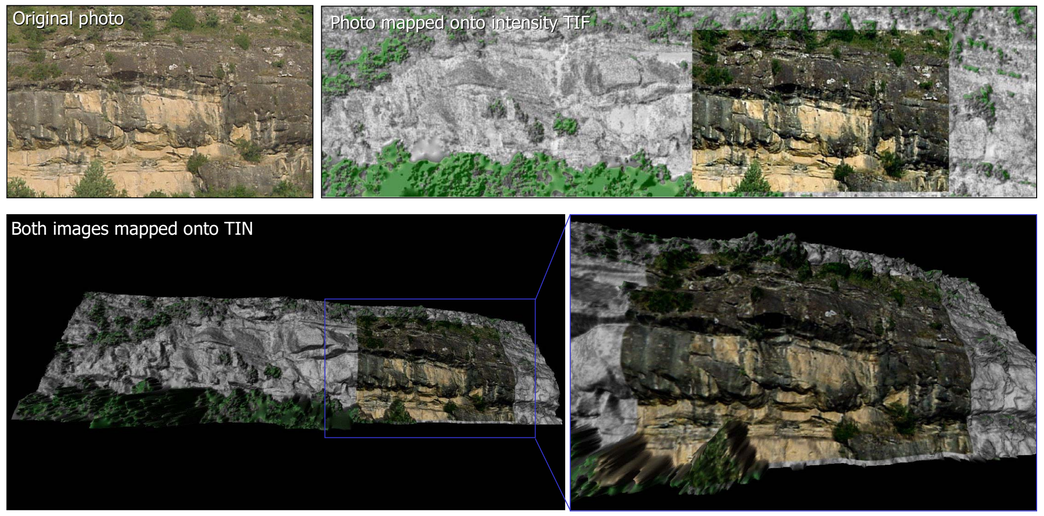
Ground-Based LIDAR Instrument:

Points and Intensity to Surface Model



1.) Point clouds are "smart-filtered" to eliminate excessive data overlap and normalize point distribution across the outcrop surface. This step is extremely important to minimize file size and keep sufficient detail to accurately represent the true surface of the outcrop. 2.) The filtered x, y, and z data are then used to generate a TIN terrain model. 3.) A full-resolution intensity image is then matched to the terrain model. Since the intensity is from the x, y, and z laser return it matches exactly to the TIN. 4.) The result is a pseudo-black and white 3D photograph derived from laser-returned x, y, z and intensity data. Multiple datasets can be merged into the same coordinate system in InnovMetric's Polyworks CAD software without GPS coordinates as long as each image has sufficient overlap with the previous and next image (10% is more than enough). Stratigraphic interpretation can begin from this stage using the intensity data much as one would use a black and white outcrop photograph.

Digital Terrain Model-Photo Merge



The process of adding a photograph to the x, y, z, and intensity model uses a "rubber-sheet" rectification technique (we used ER Mapper for this) where multiple control points are picked on each photo that correspond to points on an intensity image. Between 30 – 60 control points are used depending on the terrain complexity. Picking control points is fast and easy since the photo and the intensity image are acquired at the same time from the same vantage point. To generate a true 3D effect, we use angular variance normal to the dataset origin to define a best-fit image to color-map to the x, y, z pixels. For example, if the user wants to display all faces > 90 degrees from the normal to the TIN face with color pixels from image 1 and all faces from < 90 degrees with color pixels from image 2 this can be done using a "normal gate" as follows:

if ($\theta > 90$) then C= Image1; if $\theta < 90$ then C = Image2
where θ = viewers perspective angle with reference to face normal and C = color pixels to be mapped.

This technique allows us to map multiple images onto a single surface resulting in a full 3D textured surface. The textured surface is now optimized to any viewer perspective allowing the viewer to "see" around corners with full resolution. This technique also reduces "doubling up" of images from multiple perspectives which reduces rendering time.