

# 2. New AT Interface - Visual Analytics

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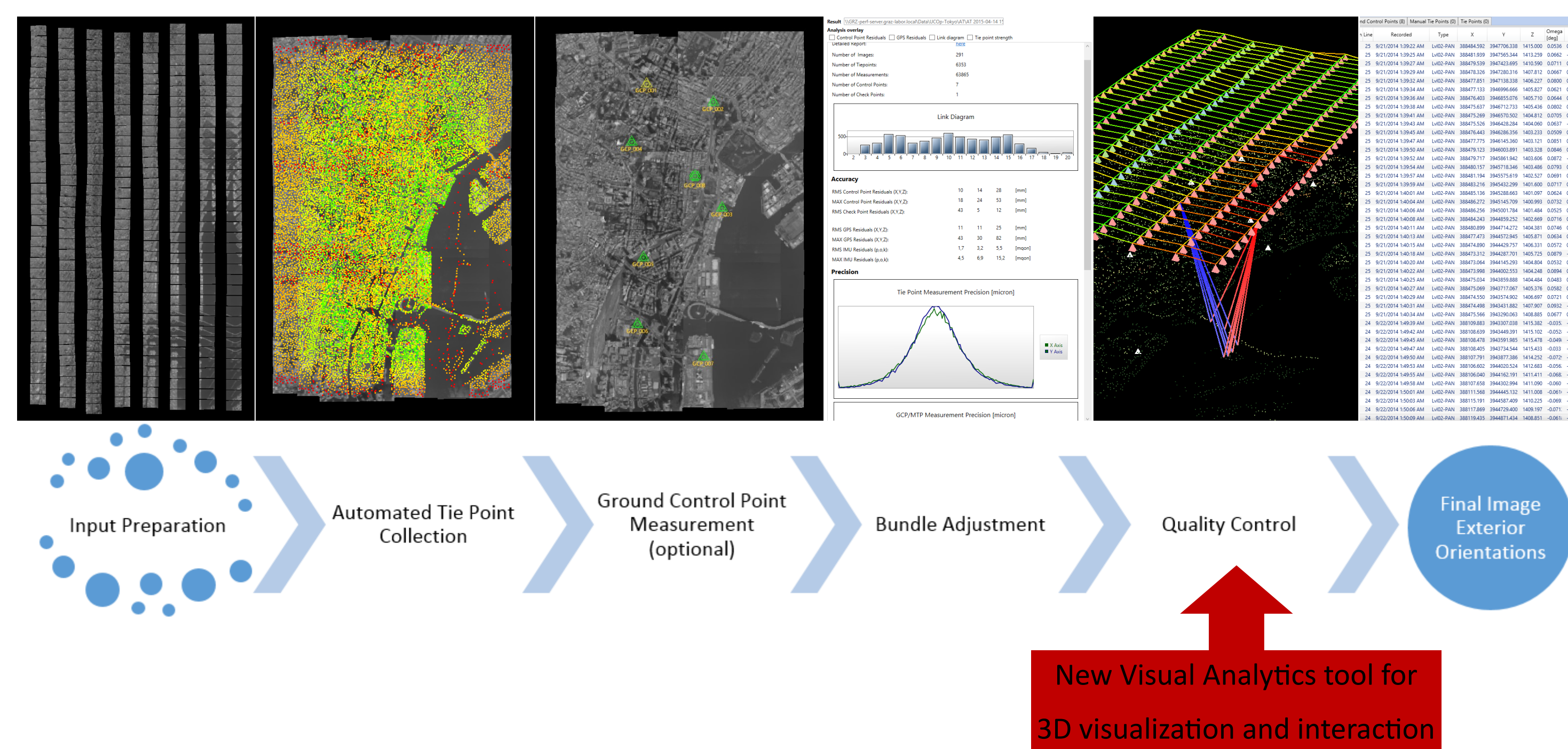
## 1 Motivation

Over the last decade the productivity of aerial operations and the demand for acquisition of large contiguous areas at increasingly higher image resolution has grown tremendously. To address those customer needs, Vexcel Imaging has regularly developed increasingly more efficient aerial camera products. Today the UltraCam Eagle with a 260 MPixel frame format and a 20.010 Pixel cross track image dimension is at the top of the product line. The UltraCam Eagle was even exceeded by the UltraCam G sensor which was used for the largest photogrammetry project ever, the so-called Global Ortho project which was successfully completed in 2014. A complete ortho mosaic (30 cm GSD) covering the 48 states of the continental US and Western Europe was the outcome of that project. The Global Ortho Program, because of the large dimensions, has triggered a good number of innovations in hardware, software, logistics, processing and more. Many of these innovations and the experience derived during the execution of the project have influenced the development of new generations of UltraCam sensors, UltraMap software, and Vexcel Imaging photogrammetry tools in general. Processing large blocks of images thus had been developed and verified years ago by Vexcel Imaging and the Microsoft Bing Imaging team and now it is introduced into the UltraMap software tools available to the commercial photogrammetry market.

## 2 Typical Workflow

The typical AT workflow consists of several steps as shown in the diagram below. The UltraMap software supports these tasks with highly automated functionality and provides tools for interaction and reporting.

The new tool Visual Analytics helps in the quality control steps after bundle adjustment and provides useful information for identifying the characteristics of the AT block.



## 3 Interaction in 3D

Working with large photogrammetric blocks of images requires the operator to understand a huge number of parameters, unknowns and quality indicators. Even when the automated processing was successfully performed there is always need for QA and QC intervention. As soon as the size of such blocks increases and some ten-thousand images are involved any human interaction, quality assessment and blunder detection becomes time consuming. This may be even more difficult, when multiple flight missions, often flown on different days and/or using different cameras, are combined and need to be adjusted as a single large continuous block of images. From such complex project scenarios we deduced a set of requirements and basic functionality. We found that three dimensional visualization of large sets of data allows even novice users to quickly understand the various quality parameters and to intuitively identify problem areas or specific data problems. In addition the software design allows to fix issues in the same 3D environment and to visualize in real-time the impact of any user interaction.

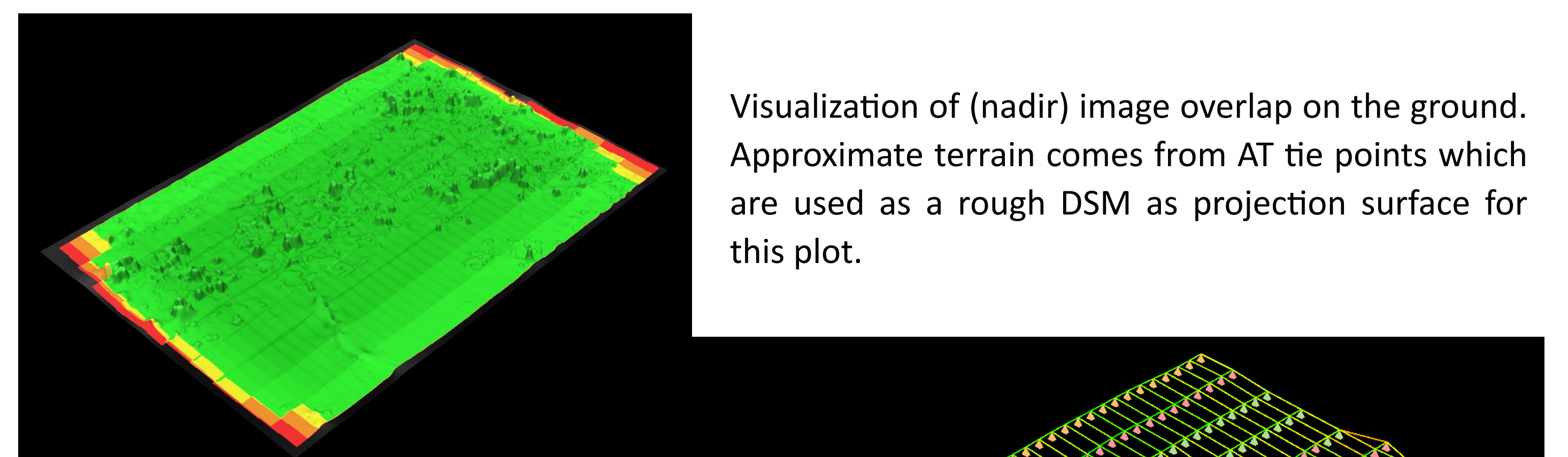
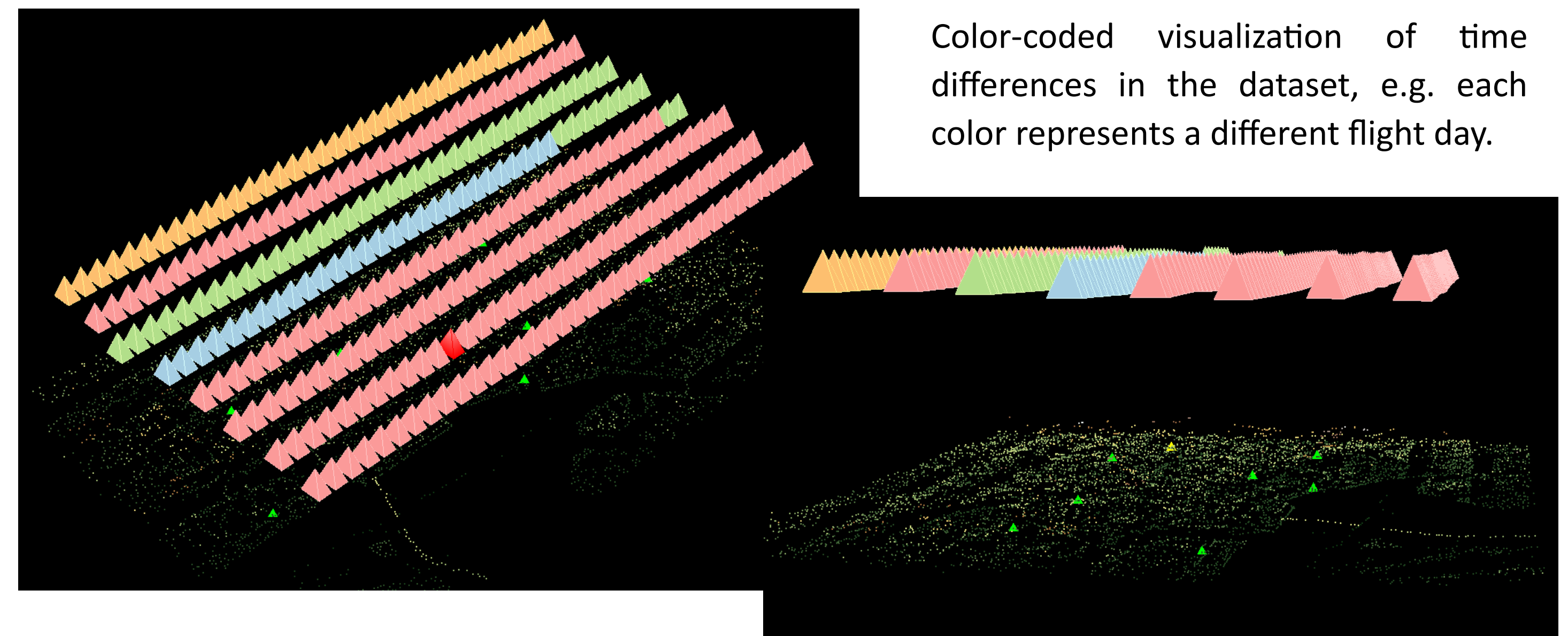
Top level functionality of the Visual Analytics tool:

- ☒ Full 3D visualization
- ☒ Color coding of parameters:
  - Date of flight mission to visualize sub blocks
  - Camera type and flight equipment to visualize sub block
  - Position parameters and/or deviations from GPS/IMU (Camera position and pose)
  - GCP and deviations after adjustment
  - GPS/IMU residuals after least squares adjustment
  - Tie point positions and strength
  - Number of shared tie points
  - Time of day differences
  - Absolute time differences
  - Link diagram of images to images
  - Link diagram of images to points
  - Link diagram of points to images
- ☒ Image Visualization

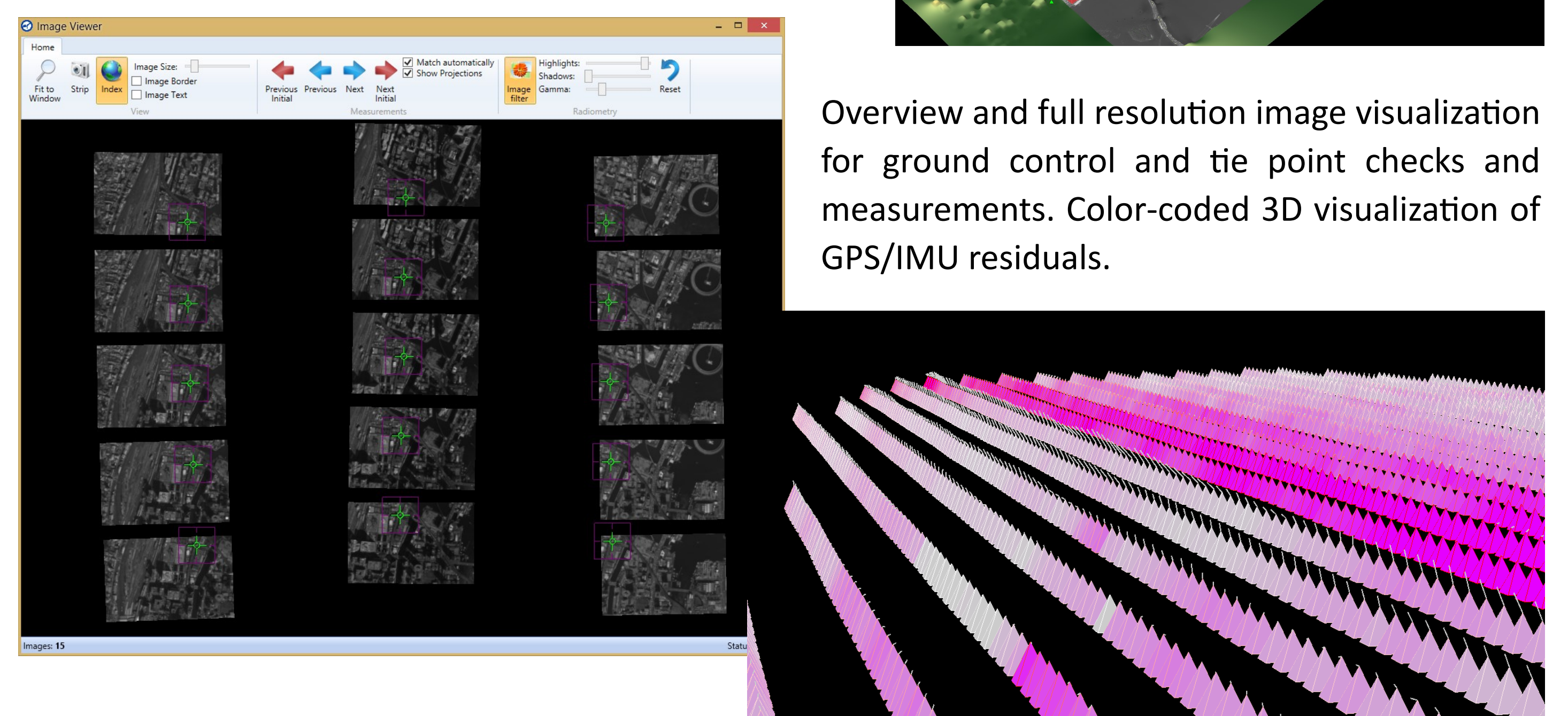
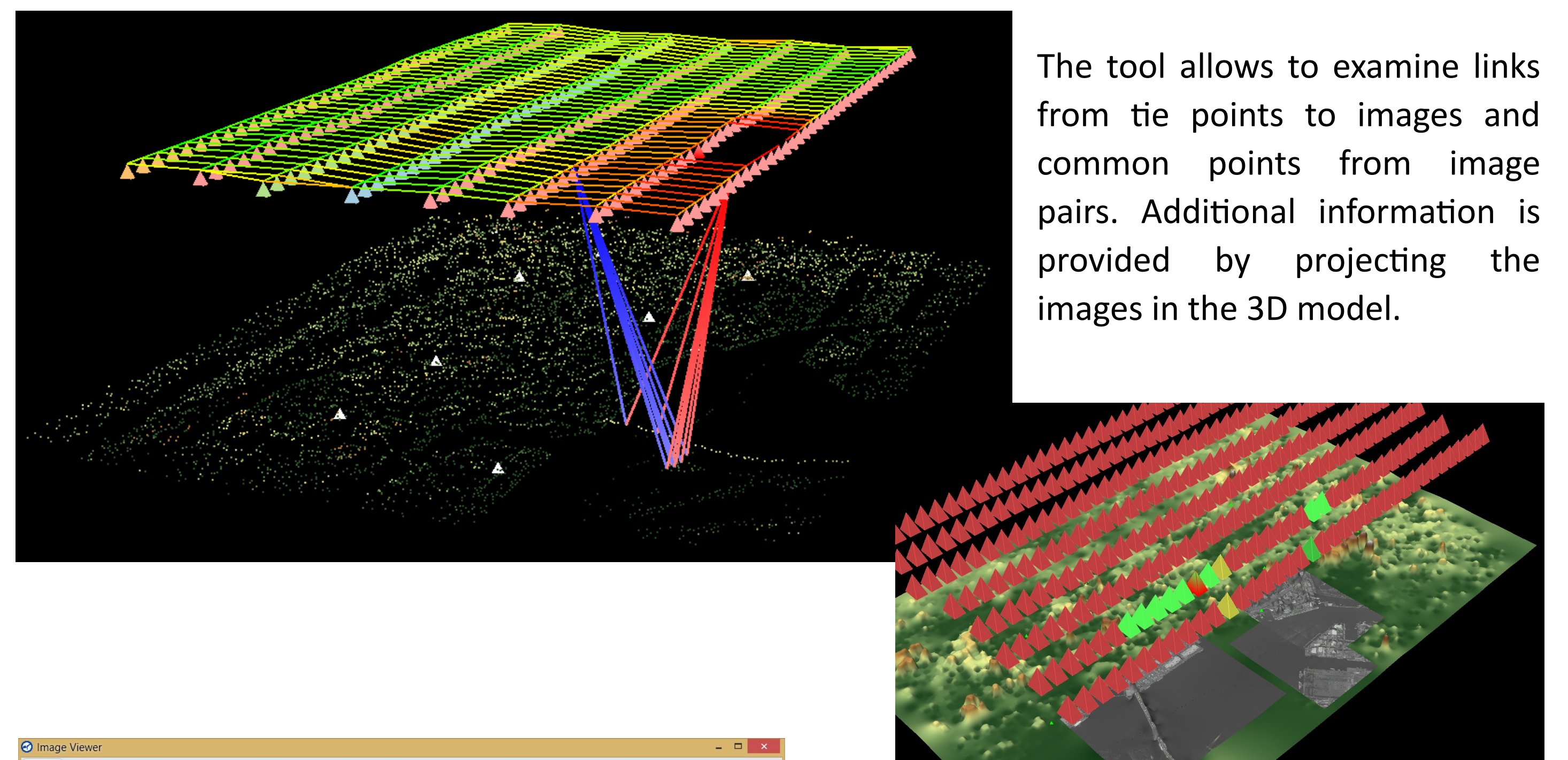
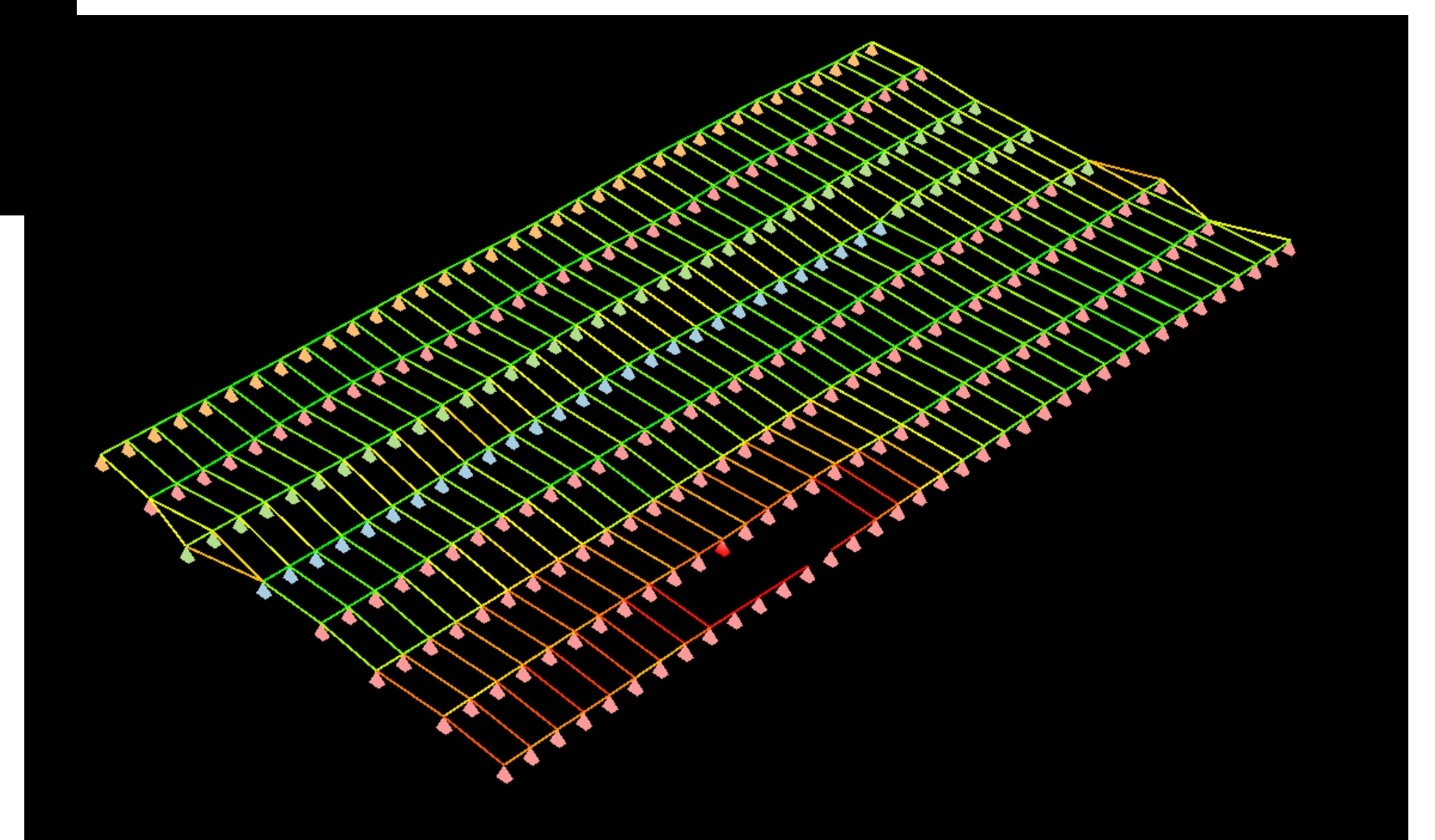
**ULTRAMAP**  
Workflow Software System

## 4 Samples

The visualizations below are screenshots from the 3D environment in the new Visual Analytics tool and give an idea of the functionality:



Link diagram: Graphical representation of images that share tie points. The graph is filtered to show only lines for direct neighbors for better readability. Colors indicate number of tie points per image pair.



## 5 Future Developments

The implementation of Visual Analytics in UltraMap v3.9 allows the visualization of essential AT data in 3D and the abstraction from an image-based visualization to a summarized visualization in vector form. Future versions will include full editing functionality for AT data in 3D and extensive integration into the processing workflow.

## Further Information

For further information and a live demonstration of our products, please visit us at booth #308.