

Changing Trends in Digital Photogrammetric Techniques A Production Perspective

By
Infotech Enterprises Ltd

Hanuman Prasad & B. Srinivasulu

Plot-11, Software Units Layout
Cybercity, Madhapur
Hyderabad, India

www.infotech-enterprises.com

Introduction:

The evolution of various work flows changed the trends in achieving high speeds with high accurate data models across the geography. The integration of existing software platforms with development of in-house tools enhances the productivity and quality ratio. Infotech believes that both the expertise on software and process implementation through management information systems in any service industry would yield the expected results. It almost took a decade to exploit the full potential of digital images by automatic processes integrated into the work flow. This paper will focus on the potentials of process optimization in real time production experiences with latest image sensor technologies. Aerial triangulation, Data mapping and Ortho photo generation are highlighted.

1.0 – Aerial Triangulation:

For the last 10 years Infotech has executed ~ 1,00,000 Imagery for Air triggering. These include both digital and also film based data. 99% of projects achieved first time acceptance from the clients across the globe.

The amalgamation of proven techno platforms like ISDM-5.1, ISAT-5.1, Match-AT-5.0, Aerosys-7.4, Bingo-5.5 and in house expertise on tool development have been used to meet the industry standards.

Experience and technology are not sole achievers of expected results but has to be coupled with the correct infrastructure that runs the software in the production floor. The residual solutions that run on a high speed systems working for more than 5000 images at a time is an important key for any success of the projects.

If we analyse the history between 2001 to 2003, mostly all projects used manual or semiautomatic approach with ISDM 4.0. The major challenges we faced were:

- 3D mouse requirement to measure the points.
- If images are more than 200 it took too much time to perform bundle adjustment. We could do around 15 images in 8 hours.
- Software errors were more while handling overlapping strips.

However between 2004 and 2007 ISDM 4.5 which had advantages over the previous version had increased the efficiency of point collection. The improvements were:

- Points could be measured with 2D mouse.
- 1000 images as a single block could be run at a stretch
- 30 images in 8 hours was possible

There were still a few challenges to overcome like:

- If points between models are less, software failed to execute
- Failed if images were more than 1000 in a block
- Failed if cross strips exists.
- Took around 6 hrs to run 900 images.
- Difficulty in handling digital images

After 2007 with the advent of ISAT-5.1 and tools development process, that we adopted, made us to stream through the present generation of high speed deliveries to meet the geographical competition. The unique developments are:

- Capable of handling 6000 images as a single block
- RO can be executed for more than 2000 images automatically in 8 hours
- Software errors minimized when compared to ISDM-4.5.
- This version was able to handle both digital and film based camera
- Bundle adjustment is fast when compared to previous versions.

2.0 Digital Data Mapping:

Data mapping is the second important task where technology and expertise are required to meet the standards and speed of the delivery expected by the industry.

During the year 2000, the models used to be compiled individually first and later merged as tiles. This practice used to create lot of topological errors. We have developed tools and defined process where in Sheet wise compilation and sheet wise data QC will be carried out using tools, built in-house, like Vectorizer, directionality check and Z residual Checker.

Infotech developed Project Management Information System (PMIS) for the first time which was embedded into the process of photogrammetry. The integration

of PMIS along with mdl tool process has emerged into a new trend of production process which enhanced both speed and quality.

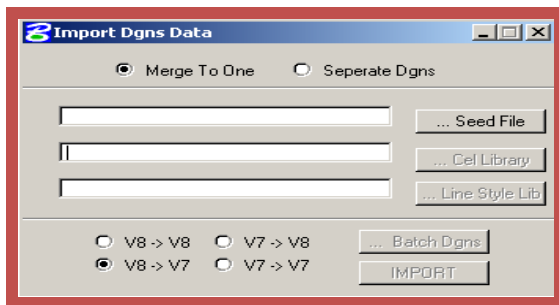
In any service oriented production flow, PMIS will give good results in analyzing errors and identifying the root cause of the error and thus improvising upon the key element in developing the tools to prevent those errors which would be fatal to productivity.

Map finishing is another important task or step which is the most crucial and delicate part of the entire process. This is a fundamental task of quality improvement and tracking. We have developed an exclusive team to handle map finishing process which has reduced the intensity of topological errors and helped in saving time of production.

We have developed various MDL tools to perform mapping and have achieved very good results in productivity and quality.

Data migration between v7 to v8 and v8 to v7 is a big challenge due to layer problems, symbology problems like element color, weight and style, snapping problems and seed file parameters. To overcome this problem, we have developed a tool which does this translation in a flawless way.

This tool will convert & rewrite all the data to destination format with mentioned seed file parameters.



Terra Modeler is another software platform which is being widely used for contour generation and feature draping. The handling time and speed are marvelous and this platform has got enough advantages to build the process with quality and speed.

With the addition of tools, built in house, further enhancements have been identified. Ortho QC check is one important task that would enhance the quality levels of the mapping job. Since mapping is related with all the ground features that are visible on the imagery and Ortho would give a complete range of data check from features missing to data connectivity. However it is to be noted here that, however strong,, the tools and auto check may be visual check is

mandatory in any photogrammetric process flow especially for Data Mapping projects.

When our process was switched to the delivery mode of ESRI platform, the thought process has become more advanced and paved way to develop a comprehensive GIS outputs. We have developed different conversion techniques like, Schema preparation, Meta data preparation; attribute conflation tools, Assigning Z elevation tools, Polygon validity tools so on and so forth.

LiDAR data sets contain vast amounts of information with buildings, trees and power lines as individual features. This data is digital and is directly processed to produce detailed bare earth DEMs at vertical accuracies from 0.05 meters to 0.35 meters. Derived products include contour maps, slope/aspect, three-dimensional topographic images, virtual reality visualizations and more. This LiDAR data is always advantageous over conventional photogrammetric mass-point collection. Time saving is more due to the speed of data collection in LiDAR technology. We can acquire 10,000 points per second as against 1,500 points per hour by the conventional manual stereo-compilation techniques.

During our continuous process development on various technological platforms we have come across many hurdles and learnt many lessons which made us develop various technological tools to enhance our process and production.

Following is a brief overview of the lessons we have learnt while using various software:

Microstation SE

- Check file size continuously while running different tools
- Check level names while conversion
- Set display depth before running any tool

Microstation-V8

- Seed file need to be checked while conversion
- Display Depth should be set before running any tool
- Check CSV file for correct conversion

Maps3D

- Change seed file before & after running maps3d applications.
- Check unlinked elements before running any application.
- Check all the flags are displayed or not while writing flags.
- Assign correct tolerances in application manager.

Terra Modeler

- Check Display Depth before generating Tin file.
- Check for the correct element types.
- Check for correct tin file while generating contours or draping features on surface.
- Check contour options before generating.

3.0 – Tool Development:

3.1 - The following are various technological tools used in Production:

(A) Name : Offset3d.ma :

Purpose: Tool to offset the element (3d) XY and Z as per the given input.

Advantages:

- Accurate offsets in both X, Y and Z directions
- Improves productivity as well as quality
- Time saving
- Easy to handle

(B) Name: placebuilding.ma :

Purpose: This tool facilitates the user to place the linear features in ortho mode on all planes i.e. in perpendicular to the last segment in a continuous line string. Various other facilities provided in this tool to place the linear features.

Advantages:

- To draw buildings with perfect orthogonality
- Auto close with ortho option available
- Vector switching to line and arc modes
- Aligning to first building while drawing

(C) Name: StreamDown.ma

Purpose: Tool used to place Stream Line in Downhill mode.

Advantages:

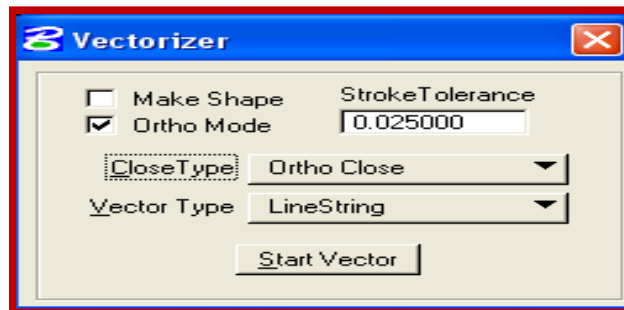
- Maintains downhill rule
- Quality of the data will improve
- Contour errors will be minimized

(D) Name: vectorizer8.ma

Purpose: Tool used to place vectors using different modes available on dialog box.

Advantages:

- While drawing we can set 'Make Shape' option.
- We can maintain perfect orthogonality with 'OrthoMode'.
- We can Specify Stroke Tolerance.
- Vector switching to line and arc modes.
- Auto close option is available

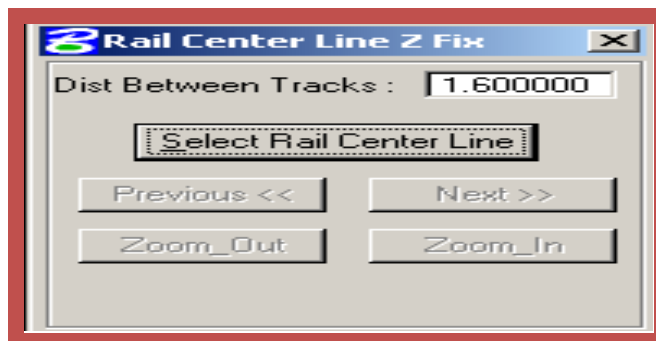


(E) name: RailCenterLineHtFix.ma

Purpose: Tool used to assign height to the centerline from the two edges. It will assign the minimum perpendicular height between two edges. Used for assigning rail centerline height in CNR Railway project.

Advantages:

- It will assign perpendicular Z values from the edges to centerlines
- It will mark error for wrong offsets, missing edges or centerlines
- It will mark error for wrong offsets, missing edges or centerlines.



3.2 - Quality Tools Demonstration:

(F) Name: CHKEDMAT

Purpose: Tool used to fix edge match errors

Advantages:

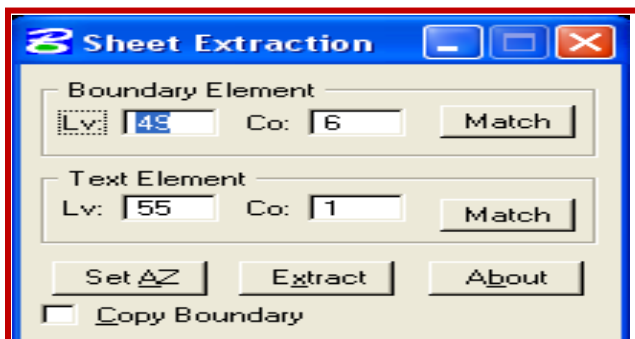
- Automatically fixes the errors within the tolerance.
- Places circles for edge match errors.
- ISaves the more time of panning all the sides
- Avoids missing errors.
- Finds undershoots and overshoots at the boundary.

(G) Name : ENTODGN

Purpose: It is used to extract the merged dgn in sheet wise at a time.
(Creating new dgn files from shapes)

Advantages:

- Works on batch mode
- Accurately clips the data to tiles
- Will not clip the cells & text elements at the boundary, will place the elements where their origin lies
- Avoids wrong tiles names, wrong files



(H) Name: FINGBLDGOVERLAP

Purpose: Tool used to find the overlaps/gaps between any buildings /any other features within the specified tolerance limits. It will not consider @ overlaps as errors.

Advantages:

- Can specify the search tolerance.
- Will not mark errors for @ linework.
- Very useful for finding gaps/overlaps between buildings.

(l) Name: SetGG_v8.ma

Purpose: Program is used to update the Graphic group Symbology. It is used to build the Graphic group numbers based on level symbology (Program to assign Graphic group as per user given text file.)

Advantages:

- Automatically assigns graphic groups as per the symbology.
- Time saving.
- Considers all the element types like line, line string, text, cells etc.,

4.0 Ortho Photo Generation:

Ortho photo production has become an affordable and highly effective source for modern GIS. The Ortho may be of any resolution or from any sensor; the basic fundamental principle always remain the same. The subjectivity is the main challenge in any ortho photo generation projects. Our Ortho Division exists since 1998 and has grown from 8 to 80 people working. The service ranges from Auto DTM generation to True ortho rectification and radiometric corrections. The challenge of ortho photo generation is not only dependent on the process or software technology but also on the use of high end infrastructure.

One important factor that is often overlooked and cause quality problems is radial distortion, commonly referred to as DTM problems. In both aerial and high-resolution satellite imagery, features are displaced outward from the center of the photograph due to elevation variations in the DTM and the perspective geometry of the sensor. These distortions are even worst towards the edges of the photograph. While mosaicking multiple images together, the ground features such as buildings and bridges are distorted along the seam line between two or more exposures. This problem is referred to as edge displacement.

Introduction of new skill sets which is a essential combination of the technologies high end machines and in-house developed tools, there has been a tremendous change and improvement in the subjectivity and subsequent increase in our productivity.

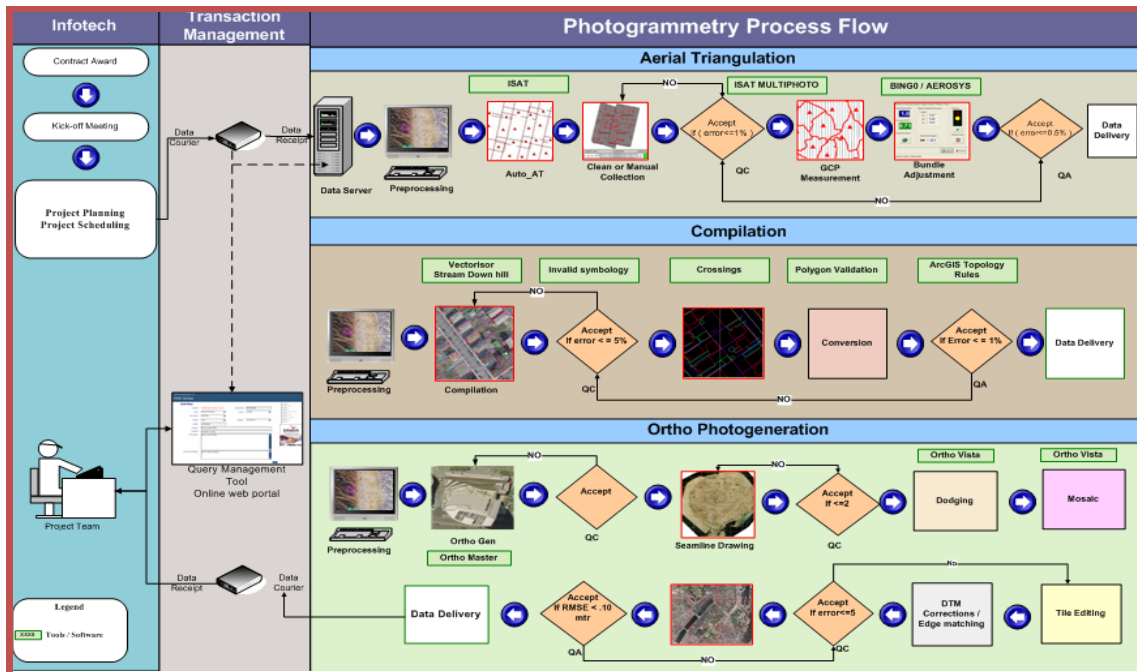
Some of the examples of the tools or batch process which enhanced our capabilities are:

- Ortho generation in Batch automatically run round the clock with a click

- Color balancing of the > 1000 images using the dodging batch to the expected master image colors and contrast.
- Auto DTM generation in batch mode for whole set of data at specified point spacing
- Auto Tie point collection helps in placing the points in the image models, which can be rectified on visual inspection for error
- Automatic True ortho generation using the drawn 3D Building models
- Automatic Seam line and Mosaic for open areas whereas the auto seam lines would be checked for CBD areas for buildings crossings
- On fly corrections for radial distortions
- Photoshop touch up.

When it comes to satellite photogrammetry, the sophisticated geometric and radiometric characteristics of high spatial resolution satellites like Cartosat and IKONOS sensors provides the end user with excellent metric accuracy and wealth of information which can be used for interpretation of terrain and various planimetric features. Infotech has made practical attempts to create 5mt DEM from Cartosat imagery to Ortho rectify 1mt IKONOS data for further process of data mapping and GIS creation. The blend between expertise and software technology has made this possible to achieve these high precision product as uniform seamless mosaic.

If we follow the below given unique process flow for any digital or film based imagery, one would definitely achieve the best results at high speed with high accuracy level



Conclusion

With the advent of advanced technologies and implementation right process approach coupled with good Project Management Information Systems, any photogrammetry service organization can serve the customers around the world with highly accurate products delivered on time. In the present world of constant changes, engineering service providers with exposure to a wide variety of technical environments would be able to successfully and efficiently cater to various segments of the industry.

Acknowledgement:

The authors are grateful to:

- Production Managers and Staff of the division for their continual efforts to make every project a success and keep the technology always at high inclination.
- Mr. Ch. Raghu Babu, Head of Photogrammetry for his continuous support in upgrading the domain expertise.

Paper Reference No.: 215

Title of the paper: Changing Trends in Digital Photogrammetric Techniques A Production Perspective

Name of the Presenter : C.Hanuman Prasad

Author (s) Affiliation: Member of INCA

Mailing Address : Plot-11, Software Units Layout, Infocity, Madhapur, Hyderabad-500081

Email Address : hanuman.chodagam@infotech-enterprises.com

Telephone number (s) : 91-40-231 10252

Fax number (s) : 91-40-231 10243

Author(s) Photograph

Hanuman Prasad

I have been working in Infotech for the last 10 years and currently look after the Commercial Geospatial segment under the UTG vertical as a senior marketing manager. Having done Masters in Technology, Earth Sciences and pursuing Doctorate in the field of GIS/Remote Sensing. With strong expertise in Geospatial Services under Project Management and Production Management I have 15 years of experience in various fields of Remote Sensing and Photogrammetry.



Srinivasulu

Mr. Srinivasulu has Masters in Technology in Remote Sensing from IIT Mumbai with over 15 years experience in GIS and Photogrammetry. Working in Infotech for the last 9 years with expertise in Geospatial Services under technical and productions Management leading team of over 200 staff for various GIS/Photogrammetry projects for clients worldwide

