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Generation of 3D Digital Elevation Model By Using Satellite Data

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Abstract— Aerial triangulation or aero triangulation is a photogrammetric term stands for the process of determining X, Y and Z ground coordinates of individual points based on measurements taken from a series of overlapping aerial photographs. This process hilly reduces the field survey work for measurement and observation of control points required to transfer the photo-coordinate system to the ground one. So, aerial triangulation is simply preserving time and reducing the cost of the projects.

Cartosat-1 stereo pair with resolution of 2.5 m is used in this work to generate a model, ie a 3D stereo view. A new block file is prepared, including the setup of camera or sensor information, including interior orientation and exterior orientation. The RPC model is used as an alternative to the rigorous model, which makes full use of the auxiliary parameters of the satellite images, and the coefficients of the model are then solved by fitting the model to the rigorous sensor model.

In order to evaluate the accuracy of aerial triangulation, number of well distributed control points were selected and observed directly in the field. LPS software was used to achieve aerial triangulation process based on a limited number of control points. Other control points were treated as check points

Digital Terrain Model is created by using the aerial triangulation as an input data, which gives the clear idea of the 3D features when view with Leica Stereoscope glass. Once each DTM has been successfully extracted, a corresponding DTM ASCII report is created. An accuracy report is created for output DTM extracted.

Index Terms— DTM, Aerial triangulation, RPC, LPS, 3D features.

1 INTRODUCTION

Photogrammetry is a branch of Remote Sensing, defined as the art, science, and technology of obtaining reliable information about physical objects and the environment. This is done through a process of recording, measuring, and interpreting aerial and terrestrial photographs. In a sense, the word photogrammetry may be analyzed in two parts: photo- meaning “picture," and grammetry - meaning "measurement." Therefore; photo-measurement.

A Digital Elevation Model (DEM) is a 3D digital representation of the Earth's terrain or topography. It can be generated from various sources like field observations, contours, and stereo data using photogrammetric techniques and by using interferometric techniques. DEM extraction involves in extraction of elevation information from imagery and subsequent creation of a 3D Digital representation of earth's surface. Creating Digital Elevation Model (DEM) by digitizing contour lines from topographic maps or through stereoscopic semi-automated methods from aerial photographs are proven methods. However, DEM generation from satellite stereo image pairs of optical and microwave sensors, is still not a common practice. The DEM generated from satellite stereo pairs have some significant advantages over the sources, like

- Worldwide availability of satellite data without any restriction (often available as archived data) as against restricted and non-availability of topographic maps and aerial photographs.
- Large area coverage per scene.
- Faster processing through sophisticated software and little manual effort.
- Low processing cost.
- All Weather and Day/Night image acquisition capabilities (in case of microwave sensors).

1.1 Aerial Triangulation

Aerial Triangulation represents the mathematical process of establishing precise and accurate relationships between the individual image coordinate systems and a defined datum and projection (ground).

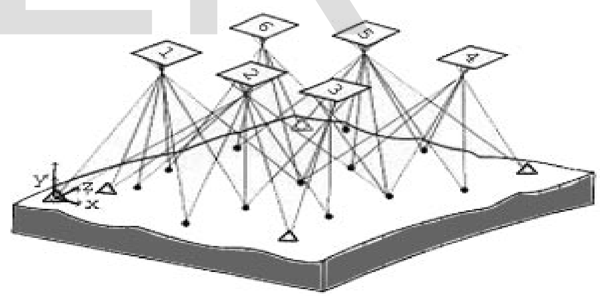

Fig -1 Ground image points

The main objective of aerial triangulation is to produce from ground control, sufficient points in the photogrammetric models to ensure that each model can be oriented accurately as required for stereo compilation.

- Triangulation is the process of contiguous densifying and extending ground control through computational means.
- This operation includes establishing ground control points; performing interior orientation, Relative orientation; measuring and transferring all tie, check, and control points appearing on all photographs; and performing a least squares block adjustment.

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- This process ultimately provides exterior orientation parameters for photographs and three-dimensional co-ordinates for measured object points.

- Aerial Triangulation is done in several steps. Those are given below

A) Interior orientation (IO)

B) Exterior orientation (EO)

C) Bundle block adjustment

2 Objective & Study area

2.1 Objective

- The main objective of the project is to generate

i) Create 3D-Stereovision by AT
ii) Create a Digital Elevation Model

- The study area is located in Hyderabad
- Hyderabad is the capital city of the state of Telangana
- Area of Interest (AOI):- 447.18 Sq mi (as show in meta data of original file next slide)

2.2 Data Used

- Cartosat-1 or IRS-P5 is a stereoscopic Earth observation satellite, and the first one of the Cartosat series of satellites. The satellite was built, launched and maintained by the Indian Space Research Organisation.
- Ground control points (x,y,z)

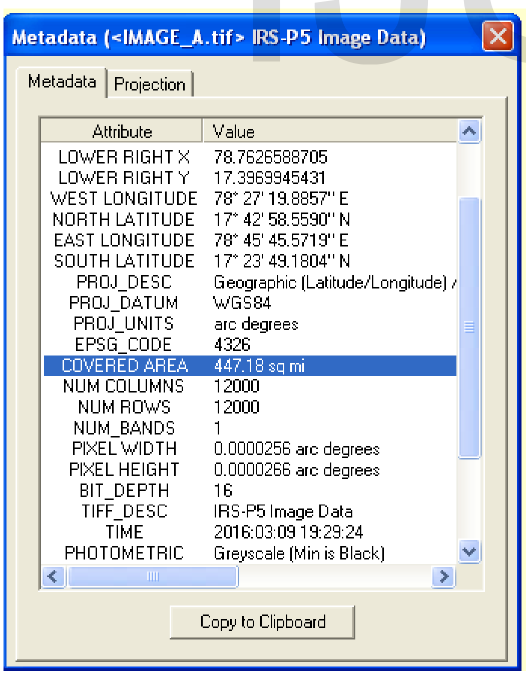
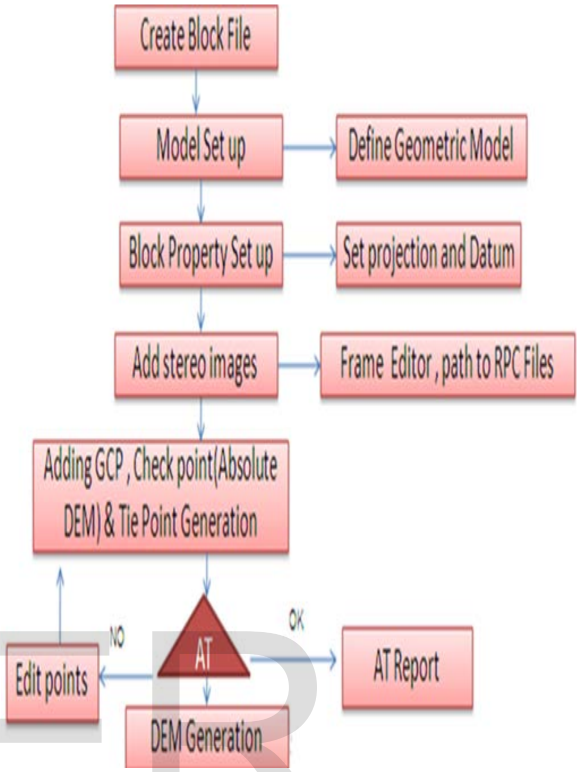


Fig -2: MetaData

2.3 Software Used

- Erdas Leica Photogrammetry Suite(LPS) 9.3 ver
- ARC GIS 9.3 ver
- Global Mapper 11.2 ver.

3 METHODOLOGY



Fi
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Flow Chart Methodology

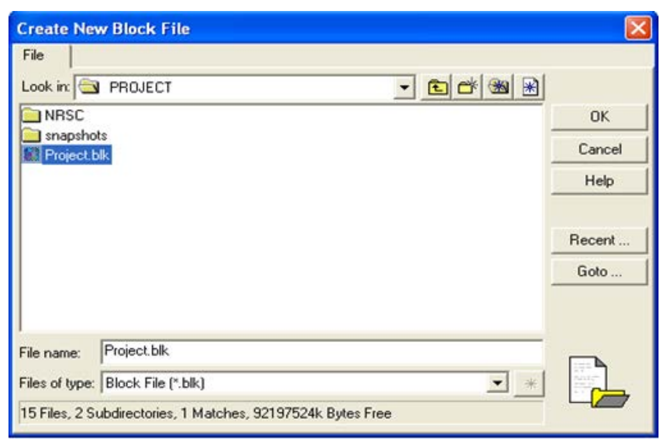

Fig -4 Block File setup

Fig -5 3-D Vision (can see with 3D Photo Glasses)

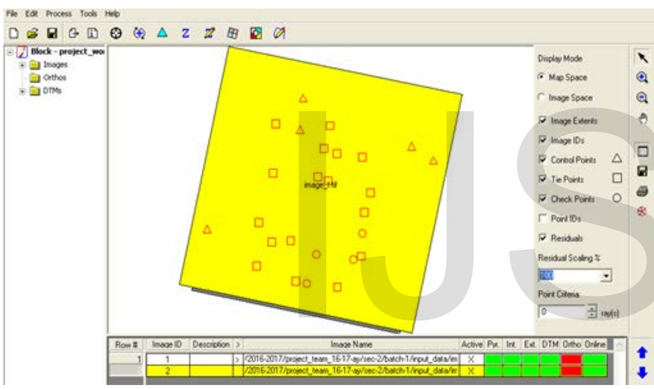

Fig -6 Graphical View of Distributed points

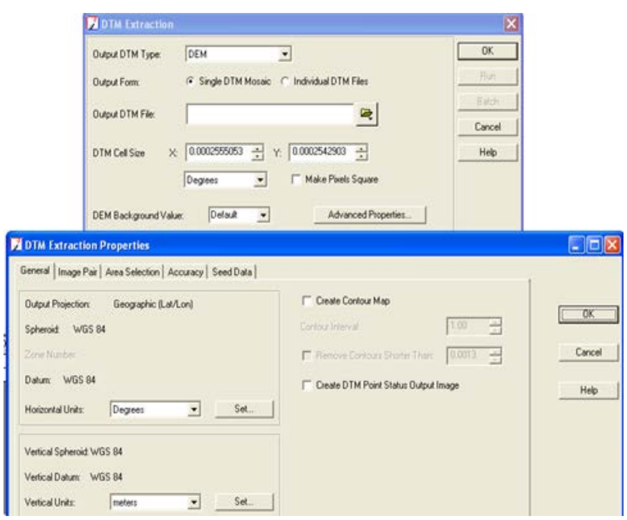

Fig -7 DEM parameters setup

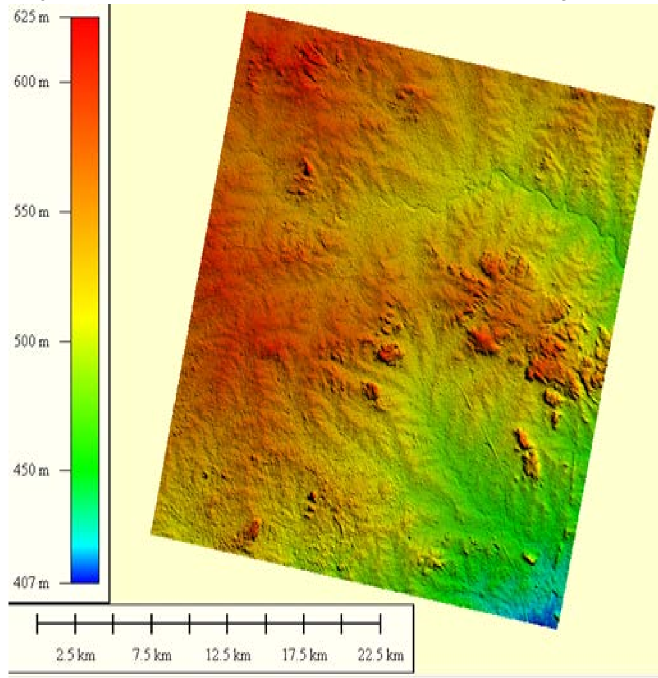

Fig -8 Generated DEM

4 RESULT ANALYSIS

- The analysis of result is carried out based on point disturbance quality as shown in fig below for AT in the slide of graphical view.
- AT accuracy shows the sigma value, which is acceptable

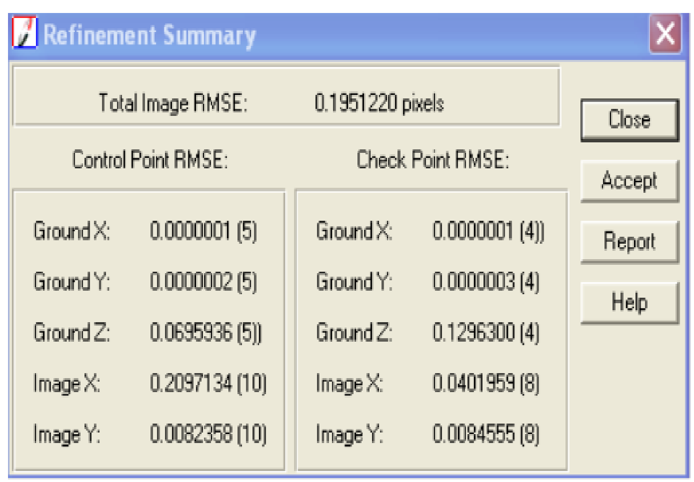

Fig -9 Refined Summary

AT Report

Adjustment Report With OrthoBASE
Output image units: pixels
Output ground units: degrees
Output z units: meters

Calculated ground x, y and z coordinates: degrees meters

type	pid	ground_x	ground_y	ground_z
gcp	1	78.58828600	17.66309055	555.33011638
gcp	3	78.71798421	17.60840706	478.37395701
gcp	5	78.58477063	17.62752312	538.31394649
gcp	9	78.74449678	17.59255991	489.23609238
gcp	17	78.47365575	17.51480541	568.01582019
chk	16	78.65971711	17.50988464	501.26457674
chk	20	78.60499450	17.48563872	505.01269874
chk	22	78.64894310	17.47971648	475.43186082
chk	25	78.59345246	17.45305139	520.95850093
tie	2	78.62034195	17.63187297	526.81445194
tie	4	78.55571803	17.63389230	566.32161801
tie	6	78.61343435	17.60586766	520.54420348
tie	7	78.62851427	17.60035816	531.47502968
tie	8	78.65912273	17.59643098	535.46574995
tie	10	78.55231975	17.57843616	570.19892224
tie	11	78.60577460	17.57410201	550.60121184
tie	12	78.61805079	17.56949384	547.43295683
tie	13	78.66935616	17.55611150	571.67598294
tie	14	78.66179244	17.53359607	521.66366271
tie	15	78.53536036	17.52236565	562.86388015
tie	18	78.55065624	17.49995641	542.43040668
tie	19	78.57349186	17.50151669	532.33738558
tie	21	78.65781676	17.48416476	482.90056328
tie	23	78.53263298	17.47315650	536.42318019
tie	24	78.57969410	17.45596599	516.32633478
tie	26	78.62921658	17.44950836	484.35438909

Fig -10 Aerial Triangulation Report

5 CONCLUSION

- This process reduces the field survey work for measurement and observation of control points required to transfer the photo-coordinate system to the ground one.
- So, aerial triangulation is simply preserving time and reducing the cost of the projects.
- The 3D Digital model is use full for urban area development..

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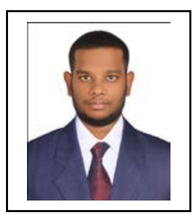
BIOGRAPHIES

Dr. SS Manugula has B.Tech Civil Engineering (1994), M.Tech Remote Sensing (1998) through GATE qualified, and Ph.D. in Civil Engineering; He worked as a Research Assistant (projects) in IIT Mumbai in the department of CSRE. He has 23 years of experience (As a Civil Engg, GIS Photogrammetry-Remote Sensing) worked with National & International Clients in various multinational companies. He worked as a Dy. General Manager& Head of GIS department and also holds the credit of gaining global exposure by working in Abu-Dhabi (UAE) as a client side side support, international project work.

Mr. Gaddam Akhil, Student of GNITC, Final year B.Tech Civil Engineering. He is the CR (class representative), He placed in two Organisations through campus drive. He participated in Institute of Engineers, International Geospatial Form and also achieved 2nd Prize in paper/ project presentations in GNI colleges.



Mr. G. Raghu vamsi, Student of GNITC, Final year B.Tech Civil Engineering., participated in Institute of Engineers, International Geospatial Form and also achieved 2nd Prize in paper/ project presentations in GNI colleges.

Mr.K.Saiteja, Student of GNITC, Final year B.Tech Civil Engineering. He is a Class representative (CR). He participated in Institute of Engineers, International Geospatial Form and also achieved Prize in paper/ project presentations in various colleges.