

Planimetric accuracy of ortho image vs Digital elevation editing using high resolution satellite data (i.e. World View-II digital stereo data) – A Pilot Study taken up under National Land Record Modernisation Programme (NLRMP) Odisha for the part of Cuttack District, Odisha, India.

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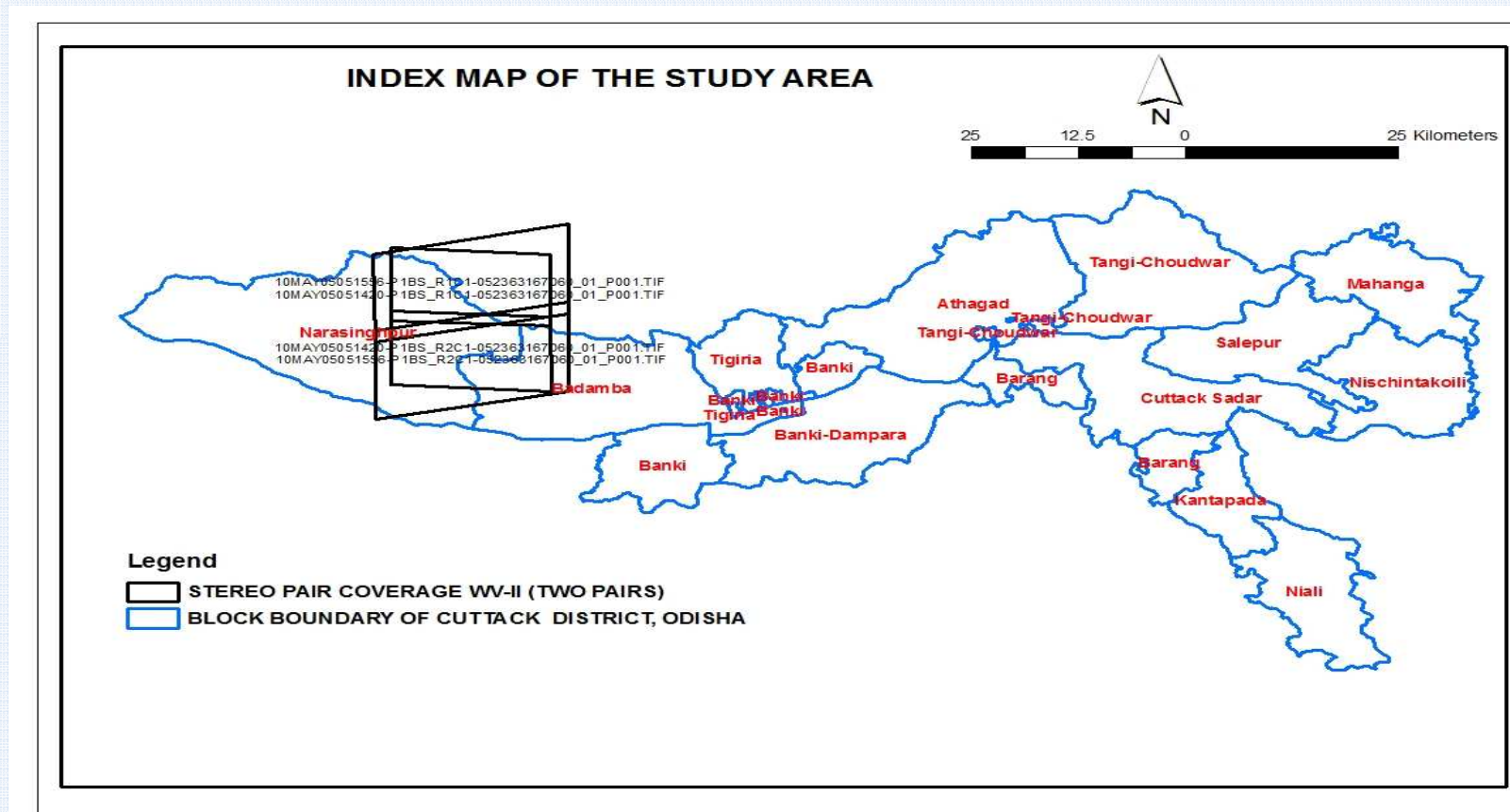
Objective of the study

The objective of this study was to find out answers of the following questions.

- 1. To generate ortho-image using an adjusted photogrammetric block prepared using WV-II stereo-images having comparative tie line measurement (image v/s field) in the range of 10 to 15 cm.**
- 2. To find out the procedure of DEM editing to achieve the desired planimetric accuracy of the ortho-image**
- 3. To make an attempt to use the combined software solutions i.e. Terrain Editor module of LPS, LPS Pro600 with Microstation, Global Mapper, etc. to reduce the man hour involvement in producing an ortho-image from one pair of WV-II.**
- 4. Involving third party vendor to get the work done in production scale following Govt. procedure.**

Study area

Part of Narsingpur and Badamba Block, Cuttack district, Odisha covered under two stereo pairs of WV-II data with a mixed terrain cover(Plain and hilly area)



DATA USED

World View – II Stereo pair

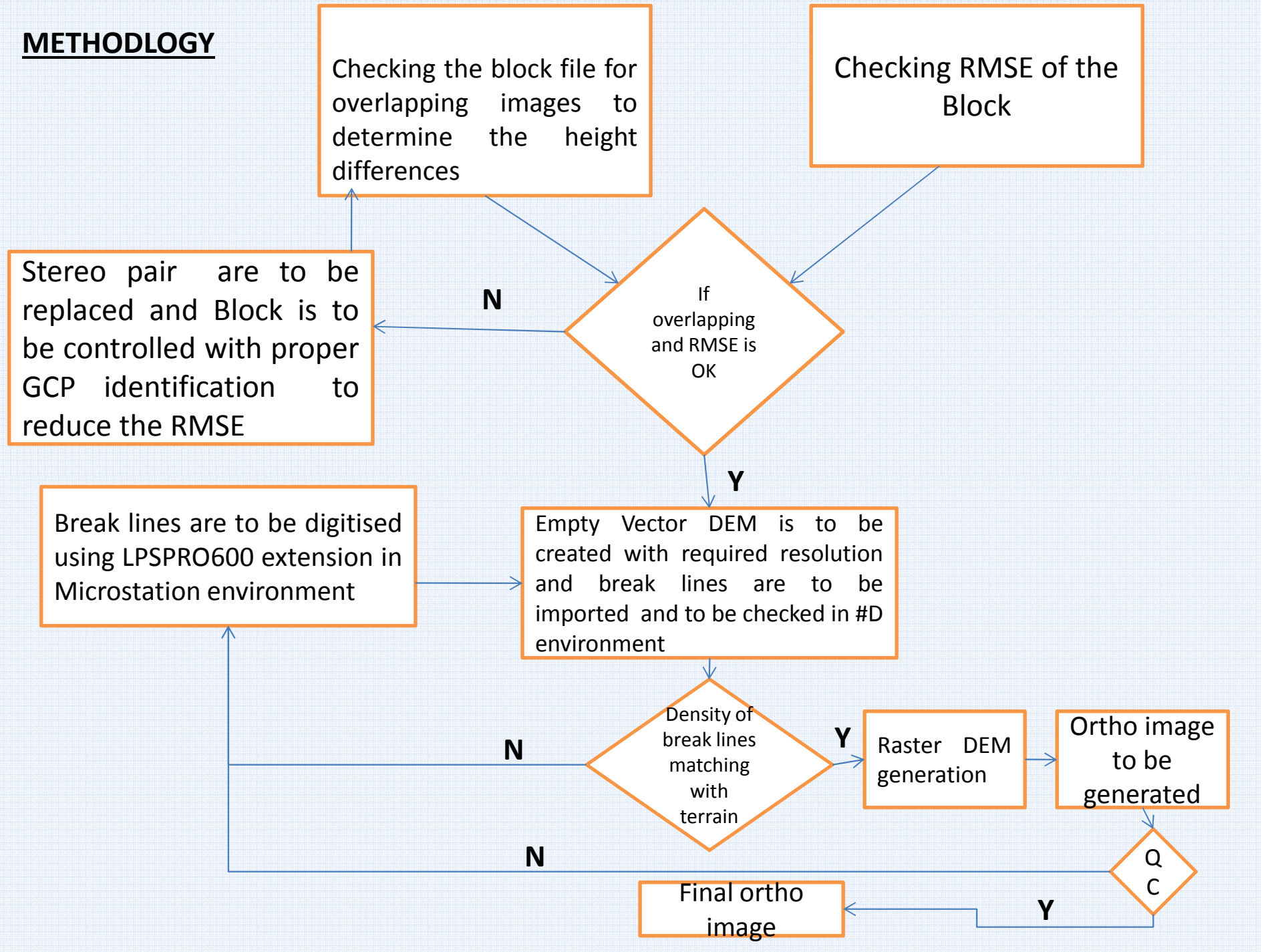
H/W USED

HP Z 800 Work Station with 32 GB 1GB NVIDIA Graphics, 3D Monitor, 3D KIT containing Infrared Emitter and 3D viewing Goggles.

S/W USED

- Leica Photogrammetric Suite (LPS) from Intergraph Corporation with the modules Core, ATE, TE, PRO 600
- Bentley Microstation
- Global Mapper

METHODOLOGY



Checking overlapping of stereo pairs & the RMSE value of Photogrammetric Block file

Also checking the value of height (Z) in the overlapping Pairs

The left screenshot shows the LPS Project Manager interface with a 3D visualization of a photogrammetric block. The block consists of multiple overlapping images, represented by red cubes. The interface includes a toolbar, a file explorer on the left, and a table of image properties at the bottom.

Row #	Image ID	Description	Image Name	Active	Pyr.	Int.	Ext.	DTM	Ortho	Online
1	1		:\3167060_01_p001_par\10may05051420-p1bs_r1c1-052363167\	✓						
2	2		:\3167060_01_p001_par\10may05051420-p1bs_r2c1-052363167\	✓						
3	5		:\3167060_01_p001_par\10may05051556-p1bs_r1c1-052363167\	✓						
4	6		:\3167060_01_p001_par\10may05051556-p1bs_r2c1-052363167\	✓						

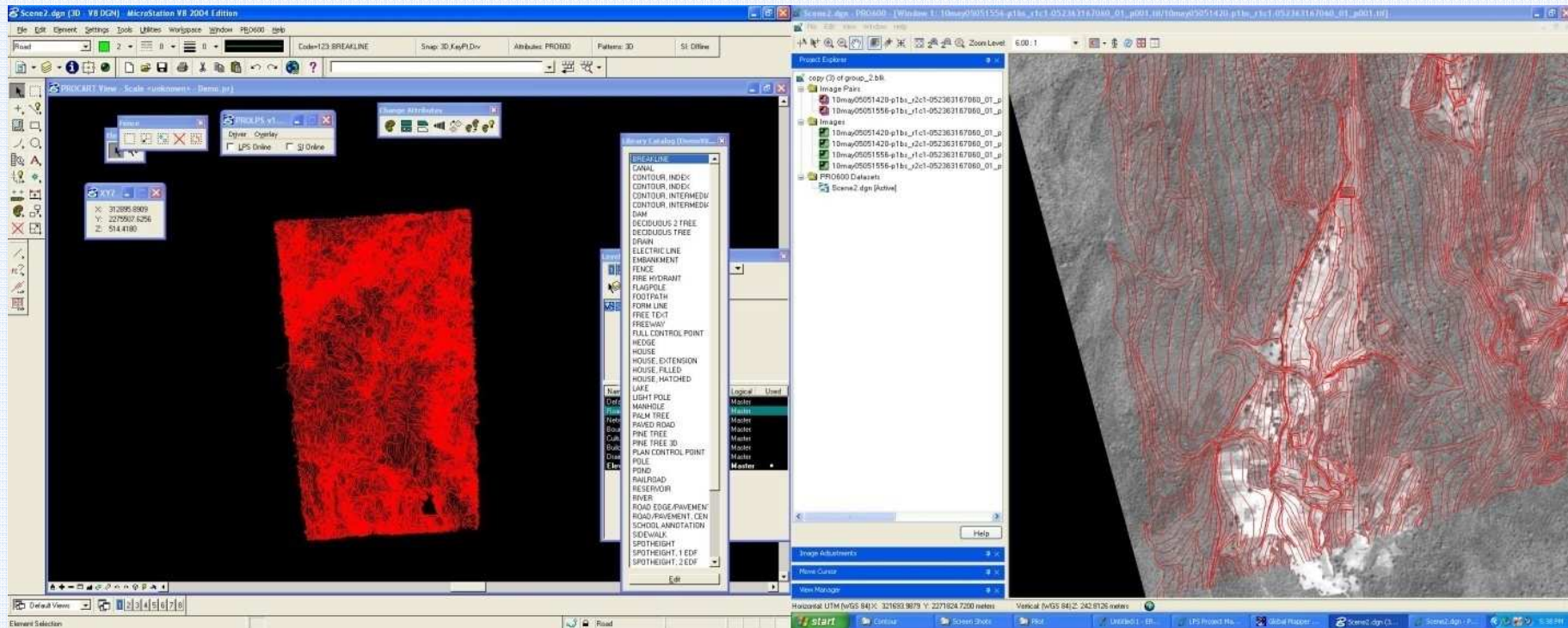
The right screenshot shows the same interface with a 'Refinement Summary' dialog box open. The dialog box displays the following information:

- Total Image RMSE: 0.0476795 pixels
- Control Point RMSE:
 - Ground X: 0.000000 (10)
 - Ground Y: 0.000000 (10)
 - Ground Z: 0.000000 (10)
 - Image X: 0.3685039 (21)
 - Image Y: 0.3298870 (21)
- Check Point RMSE:
 - Ground X: 0.1345383 (2)
 - Ground Y: 0.2975474 (2)
 - Ground Z: 0.4596843 (2)
 - Image X: 0.4442320 (4)
 - Image Y: 0.1152750 (4)

The dialog box also includes buttons for 'Close', 'Accept', 'Report', 'Review...', and 'Help'.

Row #	Image ID	Description	Image Name	Active	Pyr.	Int.	Ext.	DTM	Ortho	Online
1	1		:\3167060_01_p001_par\10may05051420-p1bs_r1c1-052363167\	✓						
2	2		:\3167060_01_p001_par\10may05051420-p1bs_r2c1-052363167\	✓						
3	5		:\3167060_01_p001_par\10may05051556-p1bs_r1c1-052363167\	✓						
4	6		:\3167060_01_p001_par\10may05051556-p1bs_r2c1-052363167\	✓						

In this stage, all the major break lines captured i.e. the roads, rivers, and sharp edges, streams, river bed and tops, stream edges and Hill peaks, bottoms of the hills, and sudden changes of the terrain. Break line have been exported to shape file and imported to an empty DEM (2mx2m)

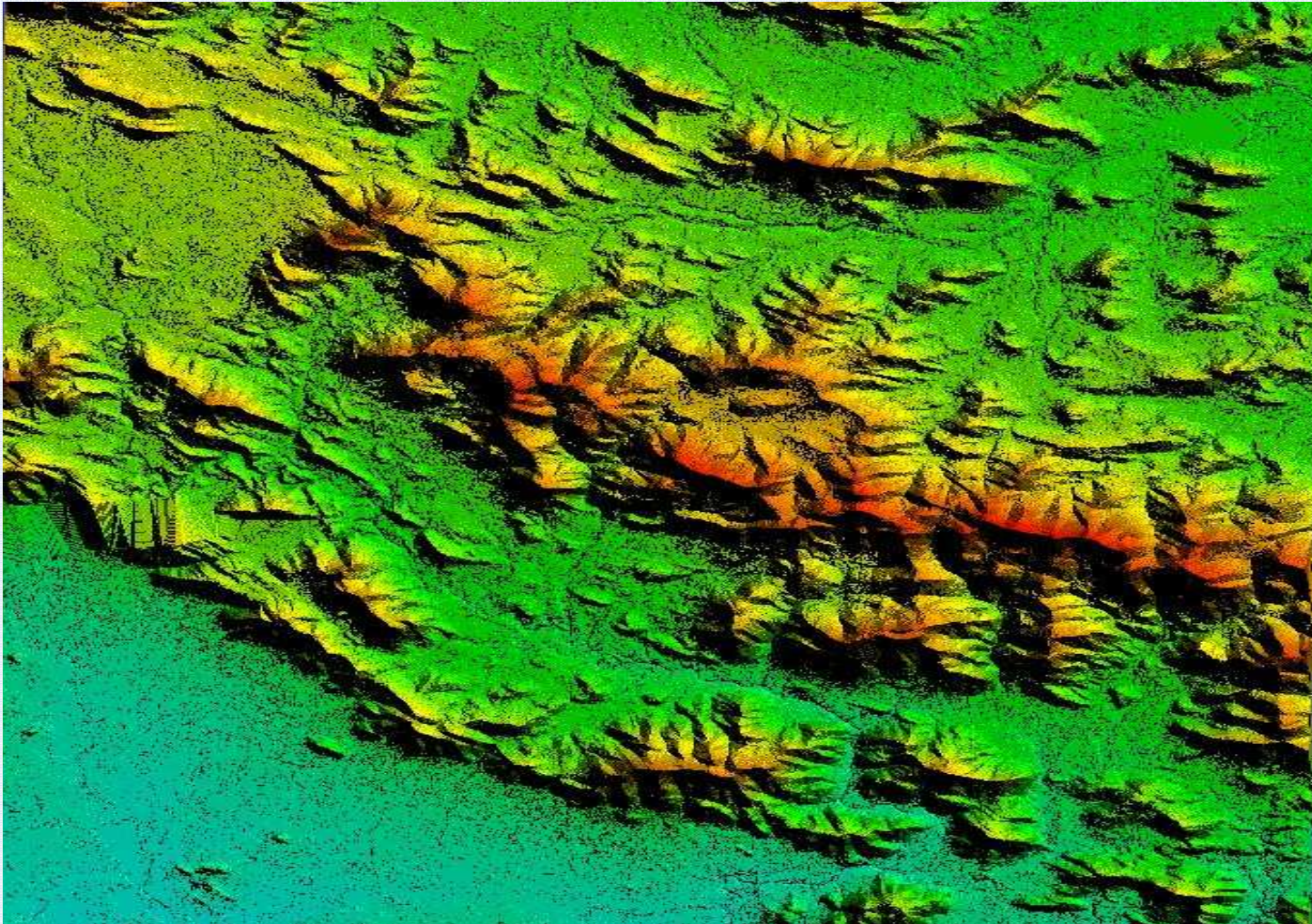


ON Line DEM Editing

Maximum part of Break lines fitted to the ground surface. If any floating and digging surface found in terrain editor, corrected the data with certain process by using terrain editor tools as provided in the software by using online contours, checked for pseudo nodes, spikes in the contour data and necessary correction were made.

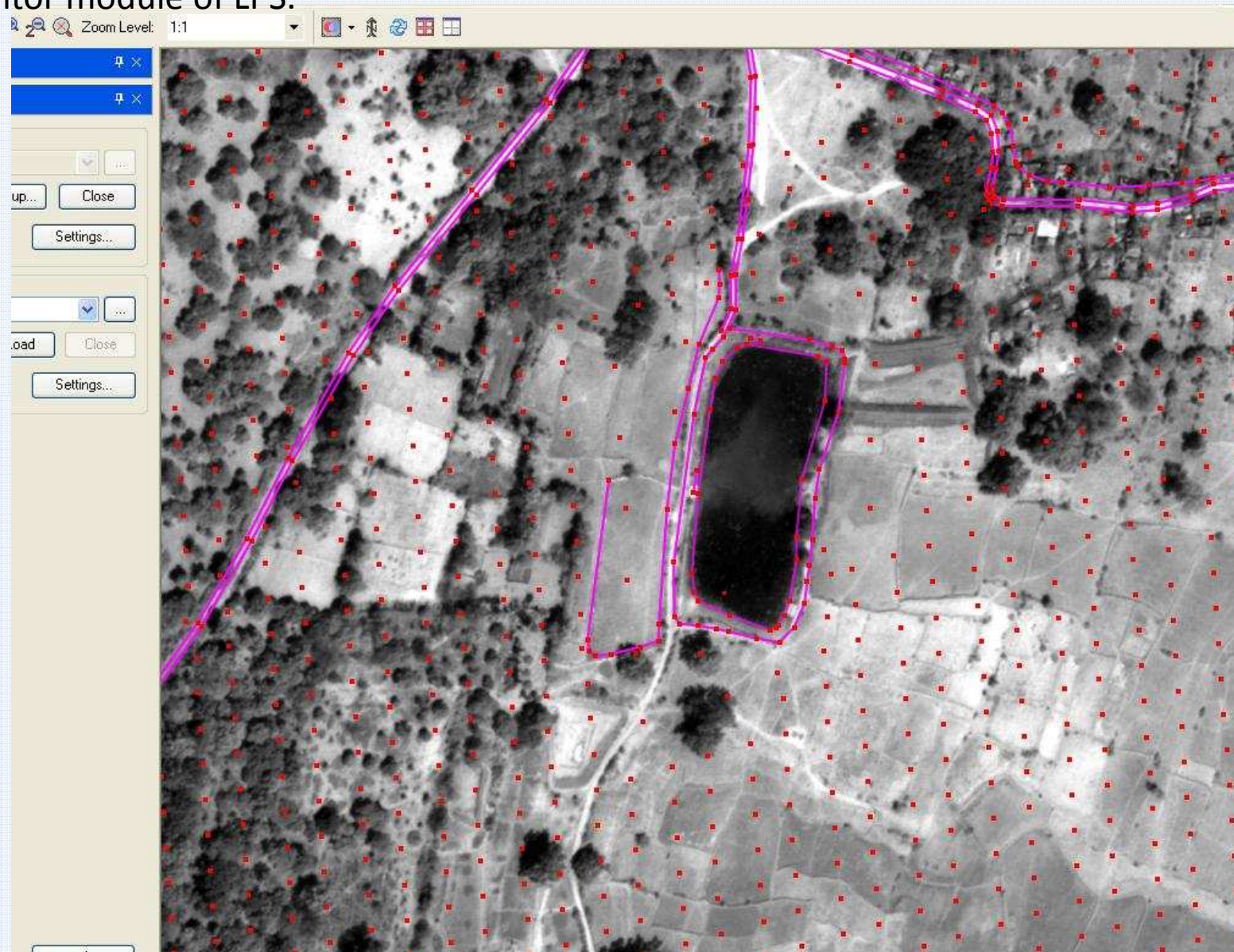
GENERATION OF RASTER DEM

A raster DEM of 2mx2m resolution was generated from the edited vector DEM.



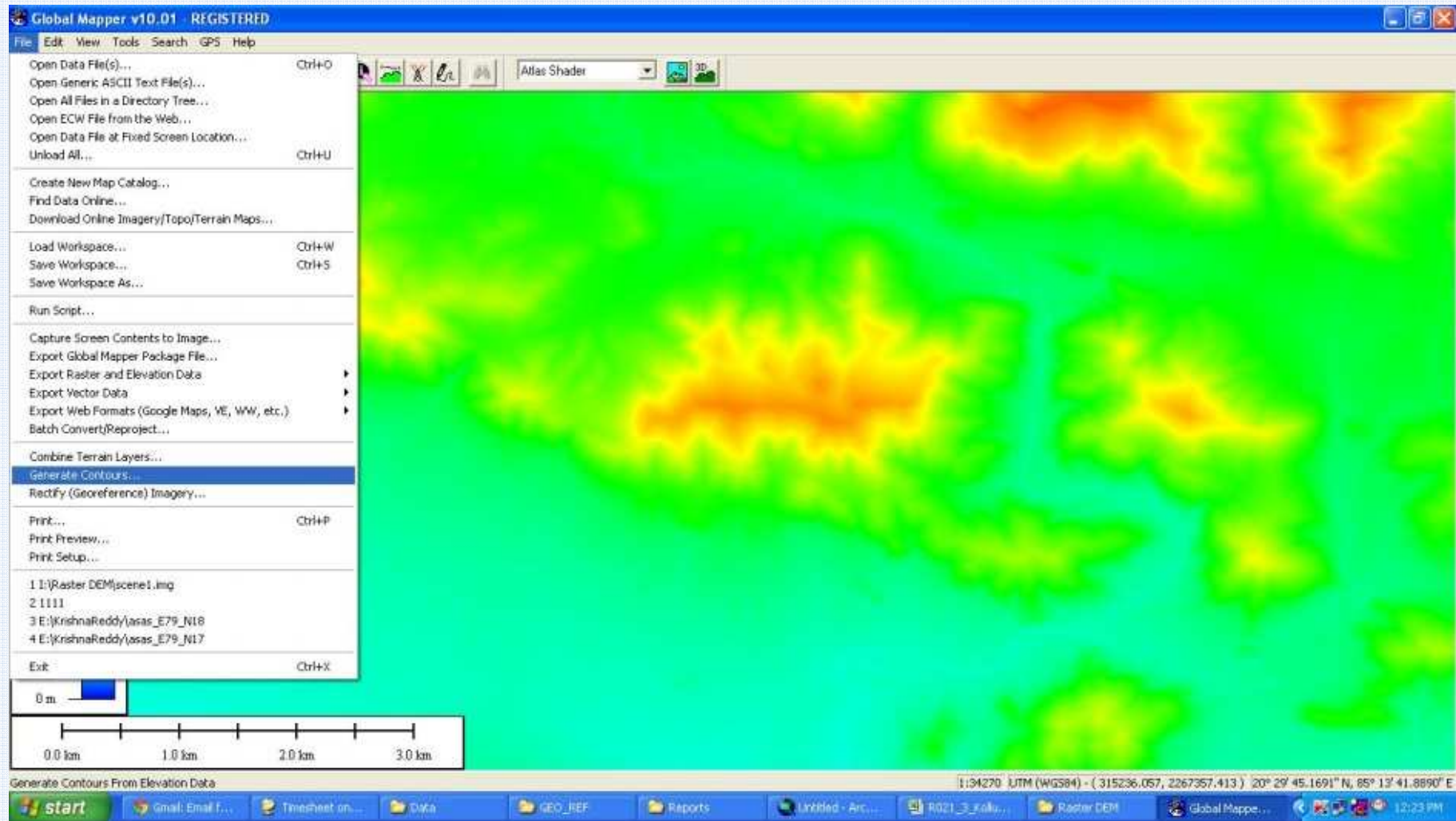
QUALITY CHECKING OF DEM

A vector DEM generated with mass points at every 2m and the edited break lines are imported to the vector DEM, which were verified in 3D environment using terrain editor module of LPS.



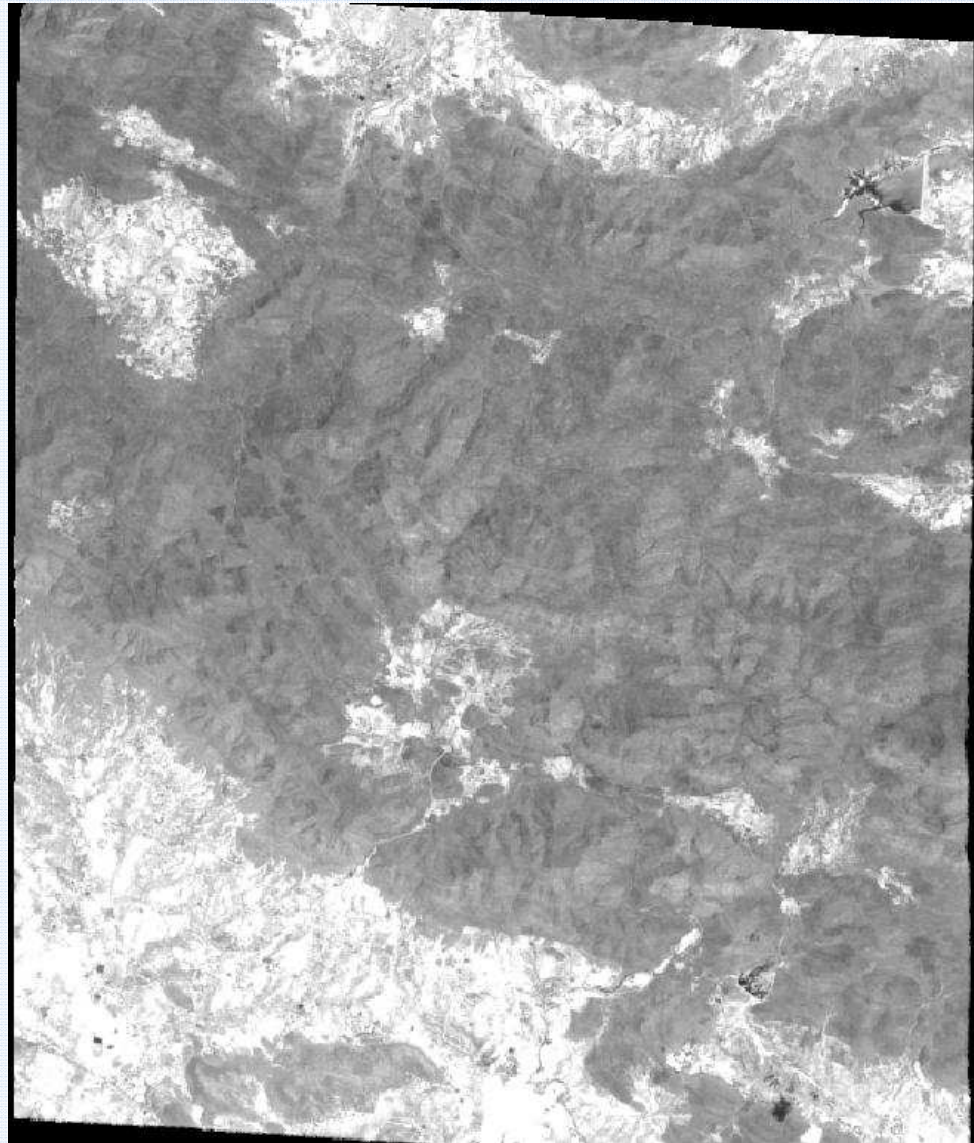
Generation of Contour

Contour vector generated having 2m height interval using Global Mapper.



Generation of Ortho-Image

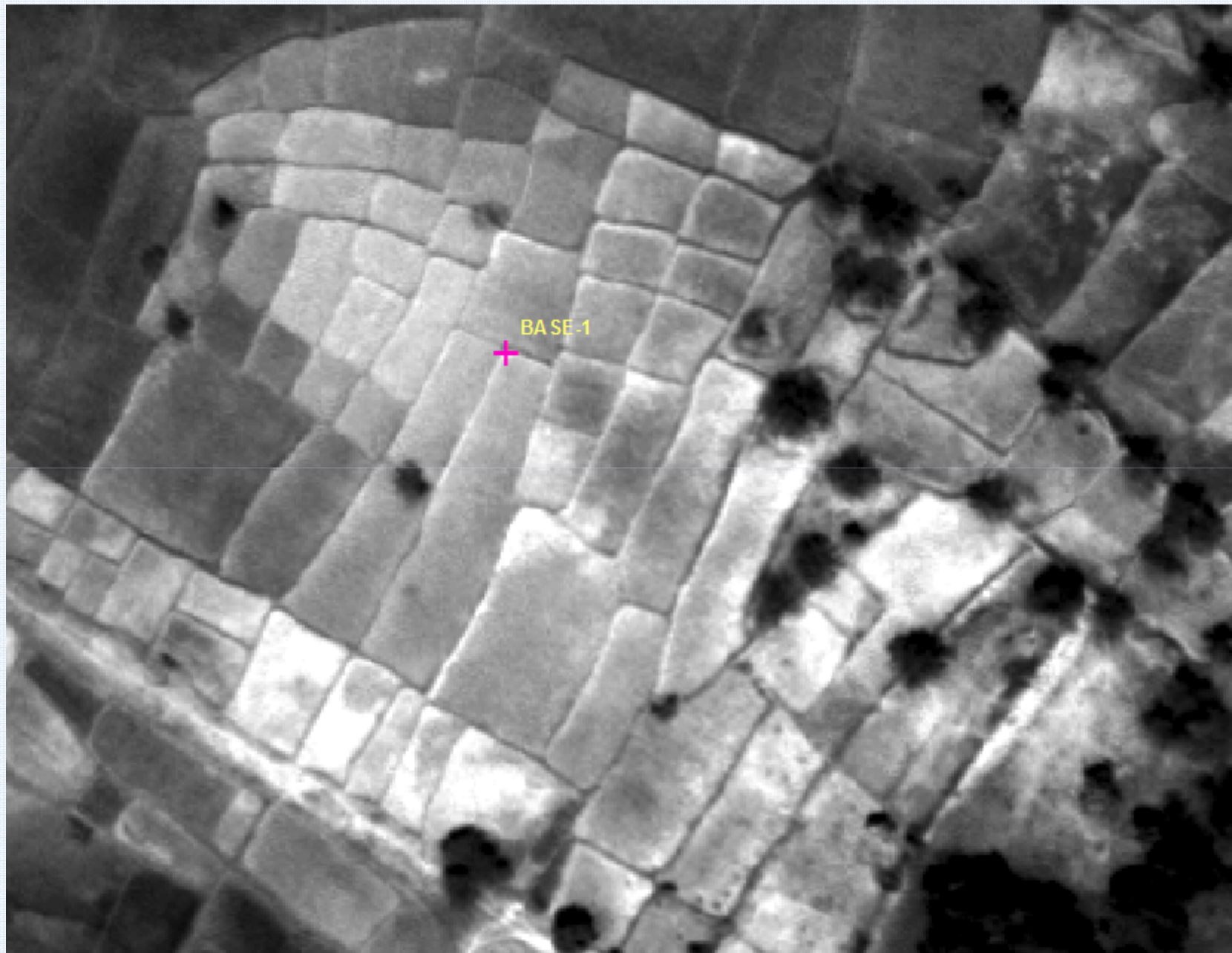
A mosaic ortho image of .5 cm resolution was generated using mosaic-pro program of LPS.



TIE LINE MEASUREMENT PLANNING ON THE ORTHO IMAGE

SL-NO	POINT_NAME	EASTING	NORTHING	PATCH_NAME
1	BASE-1-A	392310.076	2287669.046	A(P004-R1C1)
2	BASE-2-A	410704.164	2283125.148	A(P004-R1C1)
3	BASE-3-A	410649.899	2277714.78	A(P004-R1C1)
4	BASE-4-A	391935.861	2277997.696	A(P004-R1C1)
5	BASE-5-A	399660.61	2282563.414	A(P004-R1C1)
6	BASE-6-B	392133.209	2277041.711	B(P004-R2C1)
7	BASE-7-B	409657.458	2276783.896	B(P004-R2C1)
8	BASE-8-B	408845.013	2269220.936	B(P004-R2C1)
9	BASE-9-B	392102.915	2270327	B(P004-R2C1)
10	BASE-10-B	401840.908	2273421.265	B(P004-R2C1)
11	BASE-11-C	373001.609	2282595.866	C(POO7-R1C1)
12	BASE-12-C	361310.051	2285906.613	C(POO7-R1C1)
13	BASE-13-C	360043.879	2274441.876	C(POO7-R1C1)
14	BASE-14-C	375623.896	2273408.55	C(POO7-R1C1)
15	BASE-15-C	367527.184	2278974.353	C(POO7-R1C1)
16	BASE-16-D	361510.077	2272749.933	D(POO8-R1C1)
17	BASE-17-D	345861.732	2272968.572	D(POO8-R1C1)
18	BASE-18-D	346068.598	2259862.995	D(POO8-R1C1)
19	BASE-19-D	358447.467	2260051.918	D(POO8-R1C1)
20	BASE-20-D	354077.083	2268207.962	D(POO8-R1C1)
21	BASE-21-E	345911.124	2258443.83	E(P008-R2C1)
22	BASE-22-D	360342.471	2260084.984	E(P008-R2C1)
23	BASE-23-E	361143.178	2249619.08	E(P008-R2C1)
24	BASE-24-E	345093.43	2246577.502	E(P008-R2C1)
25	BASE-25-E	353300.463	2252129.236	E(P008-R2C1)

IDENTIFICATION OF BASE POINT ON THE ORTHO IMAGE



PLANIMETRIC ACCURACY MEASUREMENT COMPARISON (ORTHO IMAGE VERSUS FIELD MEASUREMENT)

SL NO	Village Name	Block Name	Distance (From-To)	Distance measured manually(mt)	Distance measured by ETS (mt)	Distance measured from ortho image	Manual -ETS	ETS-Ortho Image	Manual-Ortho Image
1	BARAPATIA	BADMBA	BASE-1	35	34.952	34.939	0.048	0.013	0.061
2	BARAPATIA	BADMBA	1_2	10	10.006	9.985	-0.006	0.021	0.015
3	BARAPATIA	BADMBA	2_3	16.87	16.879	16.861	-0.009	0.018	0.009
4	BARAPATIA	BADMBA	3_4	14.51	14.519	14.499	-0.009	0.020	0.011
5	BARAPATIA	BADMBA	BASE_4	52.14	52.145	52.161	-0.005	-0.016	-0.021
6	BARAPATIA	BADMBA	BASE_5	42.4	42.407	42.397	-0.007	0.010	0.003
7	BARAPATIA	BADMBA	1_5	55.3	55.311	55.301	-0.011	0.010	-0.001
8	BARAPATIA	BADMBA	BASE_7	56.2	56.197	56.199	0.003	-0.002	0.001
9	BARAPATIA	BADMBA	5_6	11.79	11.8	11.788	-0.01	0.012	0.002
10	BARAPATIA	BADMBA	6_7	23.78	23.786	23.888	-0.006	-0.102	-0.108
11	BARAPATIA	BADMBA	7_8	25	25.011	25.024	-0.011	-0.013	-0.024
12	BARAPATIA	BADMBA	BASE_9	32.37	32.36	32.378	0.01	-0.018	-0.008
13	BARAPATIA	BADMBA	8_9	17.33	17.329	17.347	0.001	-0.018	-0.017
14	BARAPATIA	BADMBA	BASE_10	16.24	16.22	16.198	0.02	0.022	0.042
15	BARAPATIA	BADMBA	10_11	28.1	28.093	28.084	0.007	0.009	0.016
16	BARAPATIA	BADMBA	11_12	12.81	12.801	12.825	0.009	-0.024	-0.015
17	BARAPATIA	BADMBA	12_13	52.66	52.653	52.667	0.007	-0.014	-0.007
18	BARAPATIA	BADMBA	13_1	36.12	36.116	36.132	0.004	-0.016	-0.012
19	BARAPATIA	BADMBA	10_13	64.33	64.328	64.347	0.002	-0.019	-0.017
20	BARAPATIA	BADMBA	12_1	64.71	64.705	64.719	0.005	-0.014	-0.009

PLANIMETRIC ACCURACY MEASUREMENT COMPARISON (ORTHO IMAGE VERSUS FIELD MEASUREMENT)

SL NO	Village Name	Block Name	Distance (From-To)	Distance measured manually(mt)	Distance measured by ETS (mt)	Distance measured from ortho image	Mannual -ETS	ETS-Ortho Image	Manual-Ortho Image
1	TELIKAMBILO	BADMBA	BASE_3	9.4	9.378	9.360	0.022	0.018	0.040
2	TELIKAMBILO	BADMBA	3_4	25.6	25.565	25.585	0.035	-0.020	0.015
3	TELIKAMBILO	BADMBA	3_5	46	45.851	45.885	0.149	-0.034	0.115
4	TELIKAMBILO	BADMBA	5_6	60.1	59.971	60.014	0.129	-0.043	0.086
5	TELIKAMBILO	BADMBA	6_7	12.2	12.254	12.235	-0.054	0.019	-0.035
6	TELIKAMBILO	BADMBA	7_8	35.9	35.892	35.899	0.008	-0.007	0.001
7	TELIKAMBILO	BADMBA	3_6	75.31	75.196	75.326	0.114	-0.130	-0.016
8	TELIKAMBILO	BADMBA	5_8	79.92	79.875	79.922	0.045	-0.047	-0.002
9	TELIKAMBILO	BADMBA	8_9	8.1	8.086	8.124	0.014	-0.038	-0.024
10	TELIKAMBILO	BADMBA	BASE_10	47	46.932	47.313	0.068	-0.381	-0.313
11	TELIKAMBILO	BADMBA	10_11	4.69	4.64	4.567	0.05	0.073	0.123
12	TELIKAMBILO	BADMBA	11_12	30.02	30.014	30.319	0.006	-0.305	-0.299
13	TELIKAMBILO	BADMBA	BASE_12	58.5	58.476	58.715	0.024	-0.239	-0.215
14	TELIKAMBILO	BADMBA	4_10	59.4	59.396	59.667	0.004	-0.271	-0.267
15	TELIKAMBILO	BADMBA	12_4	48.32	48.306	48.103	0.014	0.203	0.217
16	TELIKAMBILO	BADMBA	9_13	45.87	45.862	46.043	0.008	-0.181	-0.173
17	TELIKAMBILO	BADMBA	BASE_13	76.55	76.514	76.770	0.036	-0.256	-0.220

PLANIMETRIC ACCURACY MEASUREMENT COMPARISON (ORTHO IMAGE VERSUS FIELD MEASUREMENT)

SL NO	Village Name	Block Name	Distance (From-To)	Distance measured manually(mt)	Distance measured by ETS (mt)	Distance measured from ortho image	Mannual -ETS	ETS-Ortho Image	Manual-Ortho Image
1	ADHEIGUNDI	NARASINGHPUR	BASE_1	11.6	11.588	11.503	0.012	0.085	0.097
2	ADHEIGUNDI	NARASINGHPUR	1_2	4.9	4.874	4.894	0.026	-0.020	0.006
3	ADHEIGUNDI	NARASINGHPUR	2_3	13.7	13.666	13.583	0.034	0.083	0.117
4	ADHEIGUNDI	NARASINGHPUR	3_4	17.1	17.062	16.874	0.038	0.188	0.226
5	ADHEIGUNDI	NARASINGHPUR	4_5	14.65	14.643	14.605	0.007	0.038	0.045
6	ADHEIGUNDI	NARASINGHPUR	5_6	43.06	43.596	43.721	-0.536	-0.125	-0.661
7	ADHEIGUNDI	NARASINGHPUR	6_7	9	8.984	8.824	0.016	0.160	0.176
8	ADHEIGUNDI	NARASINGHPUR	7_8	9.05	9.046	9.123	0.004	-0.077	-0.073
9	ADHEIGUNDI	NARASINGHPUR	8_9	6.45	6.437	6.682	0.013	-0.245	-0.232
10	ADHEIGUNDI	NARASINGHPUR	9_10	18.5	18.473	18.037	0.027	0.436	0.463
11	ADHEIGUNDI	NARASINGHPUR	10_11	1.9	1.88	1.964	0.02	-0.084	-0.064
12	ADHEIGUNDI	NARASINGHPUR	11_12	12.25	12.207	12.287	0.043	-0.080	-0.037
13	ADHEIGUNDI	NARASINGHPUR	12_13	14.63	14.627	14.088	0.003	0.539	0.542
14	ADHEIGUNDI	NARASINGHPUR	13_14	2.88	2.867	3.209	0.013	-0.342	-0.329
15	ADHEIGUNDI	NARASINGHPUR	14_15	15.62	15.616	15.591	0.004	0.025	0.029
16	ADHEIGUNDI	NARASINGHPUR	15_16	13.29	13.279	13.129	0.011	0.150	0.161
17	ADHEIGUNDI	NARASINGHPUR	11_17	21.89	21.88	21.937	0.01	-0.057	-0.047
18	ADHEIGUNDI	NARASINGHPUR	BASE_13	22.44	22.435	22.026	0.005	0.409	0.414
19	ADHEIGUNDI	NARASINGHPUR	1_12	24.65	24.632	24.146	0.018	0.486	0.504
20	ADHEIGUNDI	NARASINGHPUR	1_17	50.33	50.322	50.079	0.008	0.243	0.251
21	ADHEIGUNDI	NARASINGHPUR	BASE_10	25.87	25.863	25.352	0.007	0.511	0.518
22	ADHEIGUNDI	NARASINGHPUR	9_12	22.36	22.362	22.466	-0.002	-0.104	-0.106

PLANIMETRIC ACCURACY MEASUREMENT COMPARISON (ORTHO IMAGE VERSUS FIELD MEASUREMENT)

SL NO	Village Name	Block Name	Distance (From-To)	Distance measured manually(mt)	Distance measured by ETS (mt)	Distance measured from ortho image	Mannual -ETS	ETS-Ortho Image	Manual-Ortho Image
1	KANDHAL	NARASINGHPUR	BASE_1	13	12.997	12.615	0.003	0.382	0.385
2	KANDHAL	NARASINGHPUR	1_2	1.75	1.743	1.709	0.007	0.034	0.041
3	KANDHAL	NARASINGHPUR	2_3	18.6	18.582	17.752	0.018	0.830	0.848
4	KANDHAL	NARASINGHPUR	3_4	43.26	43.256	43.153	0.004	0.103	0.107
5	KANDHAL	NARASINGHPUR	4_5	16.42	16.414	16.540	0.006	-0.126	-0.120
6	KANDHAL	NARASINGHPUR	2_5	41.43	41.427	41.650	0.003	-0.223	-0.220
7	KANDHAL	NARASINGHPUR	BASE_5	44.2	44.205	44.653	-0.005	-0.448	-0.453
8	KANDHAL	NARASINGHPUR	BASE_6	40.7	40.691	40.907	0.009	-0.216	-0.207
9	KANDHAL	NARASINGHPUR	1_6	43.89	43.889	44.312	0.001	-0.423	-0.422
10	KANDHAL	NARASINGHPUR	BASE_7	49.55	49.535	49.315	0.015	0.220	0.235
11	KANDHAL	NARASINGHPUR	6_7	33.45	33.432	34.107	0.018	-0.675	-0.657
12	KANDHAL	NARASINGHPUR	BASE_8	31.57	31.558	31.789	0.012	-0.231	-0.219
13	KANDHAL	NARASINGHPUR	7_8	40.1	40.089	40.317	0.011	-0.228	-0.217
14	KANDHAL	NARASINGHPUR	BASE_9	20.95	20.942	21.261	0.008	-0.319	-0.311
15	KANDHAL	NARASINGHPUR	8_9	10.67	10.636	10.116	0.034	0.520	0.554
16	KANDHAL	NARASINGHPUR	9_10	45.5	45.496	45.765	0.004	-0.269	-0.265
17	KANDHAL	NARASINGHPUR	10_11	10.56	10.552	11.119	0.008	-0.567	-0.559
18	KANDHAL	NARASINGHPUR	8_11	46.59	46.59	47.139	0	-0.549	-0.549
19	KANDHAL	NARASINGHPUR	10_12	31.68	31.665	31.759	0.015	-0.094	-0.079
20	KANDHAL	NARASINGHPUR	1_10	57.76	57.758	58.327	0.002	-0.569	-0.567
21	KANDHAL	NARASINGHPUR	9_12	52.26	52.26	52.131	0	0.129	0.129

FINDINGS

The following findings are derived from this study.

- The RMSE of the controlled Block shall be equal to or less than .20 of pixels, taking World View-II stereo pair images and GCPs taken using DGPS.
- The break lines shall be captured at every height change in the terrain matching with DEM resolution.
- Combined initiative shall be taken to capture the break lines using PRO600 of LPS with Microstation to complete one WV-II scene of 200 sq kms. by splitting the scene into many parts and distributing among the persons.
- Online editing of break lines and Contours shall be done at expert level to decide further addition of break lines, if left out.
- Tie line measurements from the ortho image where dimension of individual parcels are measured from the field and image, found to be in the range of 10 to 15 cm variation.

Thanks