TÜRKİYE CUMHURİYETİ

KOCAELİ ÜNİVERSİTESİ

MÜHENDİSLİK FAKÜLTESİ

HARİTA MÜHENDİSLİĞİ

TASARIM PROJESİ ÖDEV I

GitHub ile ödevin dosyalarına buradan ulaşabilirsiniz.

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HAZIRLAYANLAR

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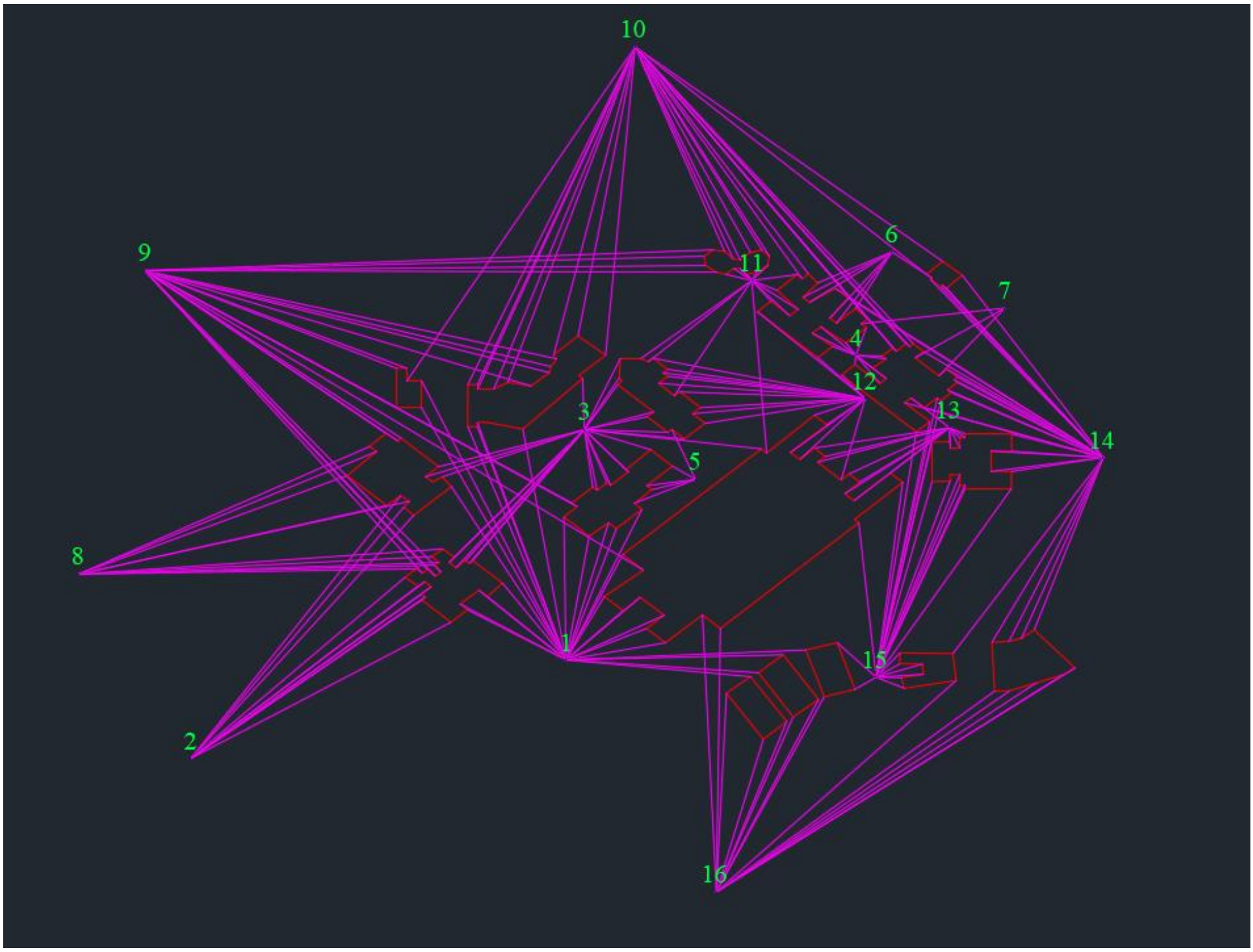
1-a)

Çalışmaya ilk olarak şekil-1’deki bina detaylarını Civil 3d programında çizerek işe başladık, Ardından tüm detay noktalarını görecek şekilde bir poligon ağı tasarladık. Poligon ağı tasarlarken olabildiğince az nokta atmaya ve gereksiz, birbirine çok yakın noktalar atmamaya özen gösterdik.

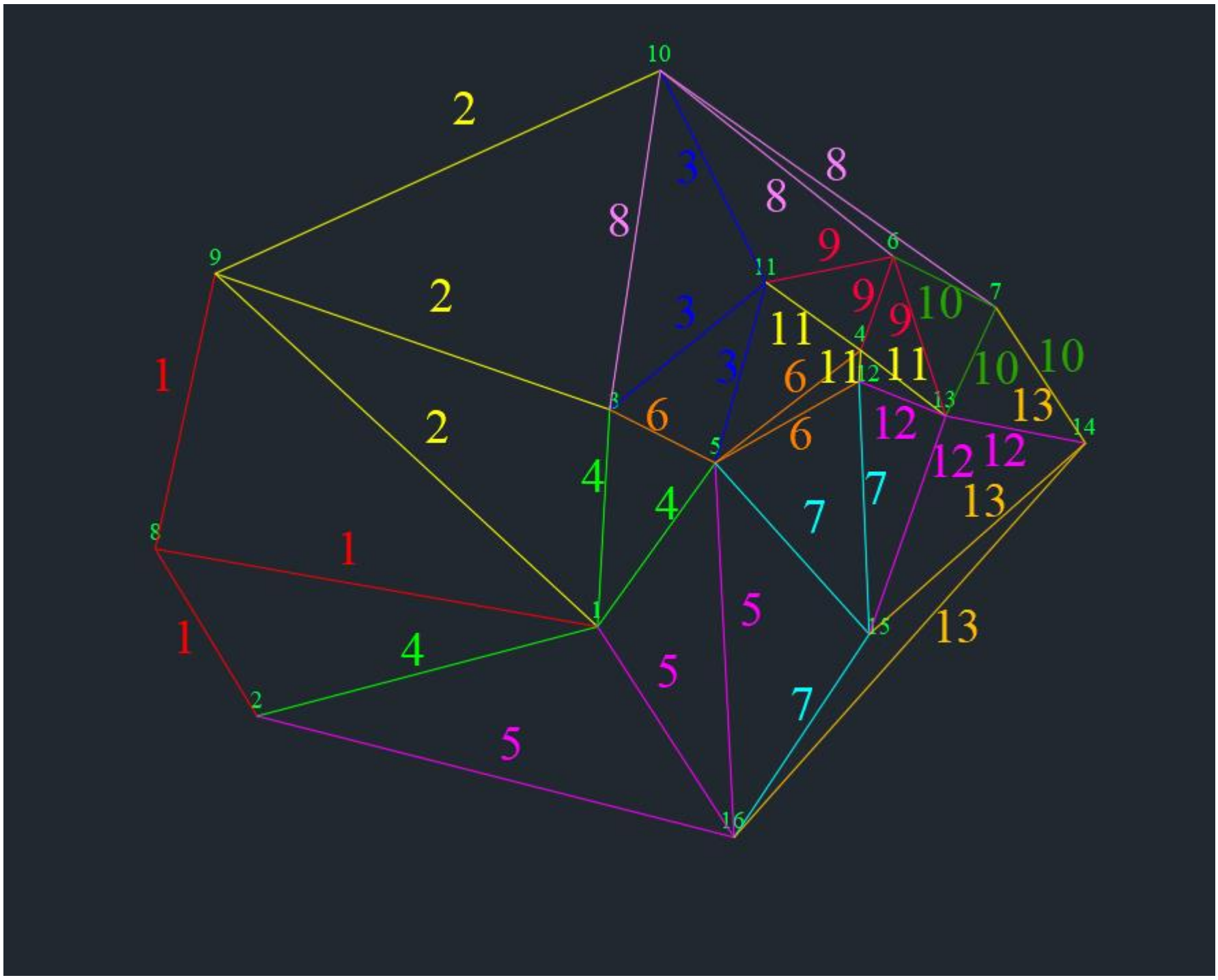
1-b)

Uygulamada poligon ağı tasarlama işleminin ardından poligon noktalarının bina köşelerini gördüğünü Civil 3D programı ile durum görüş krokisi oluşturarak kanıtladık.



1-c)

Tasarladığımız ağa uygun bir şekilde GNSS ölçü planı oluşturduk. (4 adet GNSS alıcımız var.)



Durulan 8 -> 9, 1, 2

Durulan 9 -> 10, 3, 1

Durulan 11 -> 5, 3, 10

Durulan 1 -> 2, 3, 5

Durulan 16 -> 2, 1, 5

Durulan 5 -> 3, 4, 12

Durulan 15 -> 16, 5, 12

Durulan 10 -> 7, 6, 3

Durulan 6 -> 13, 4, 11

Durulan 7 -> 14, 13, 6

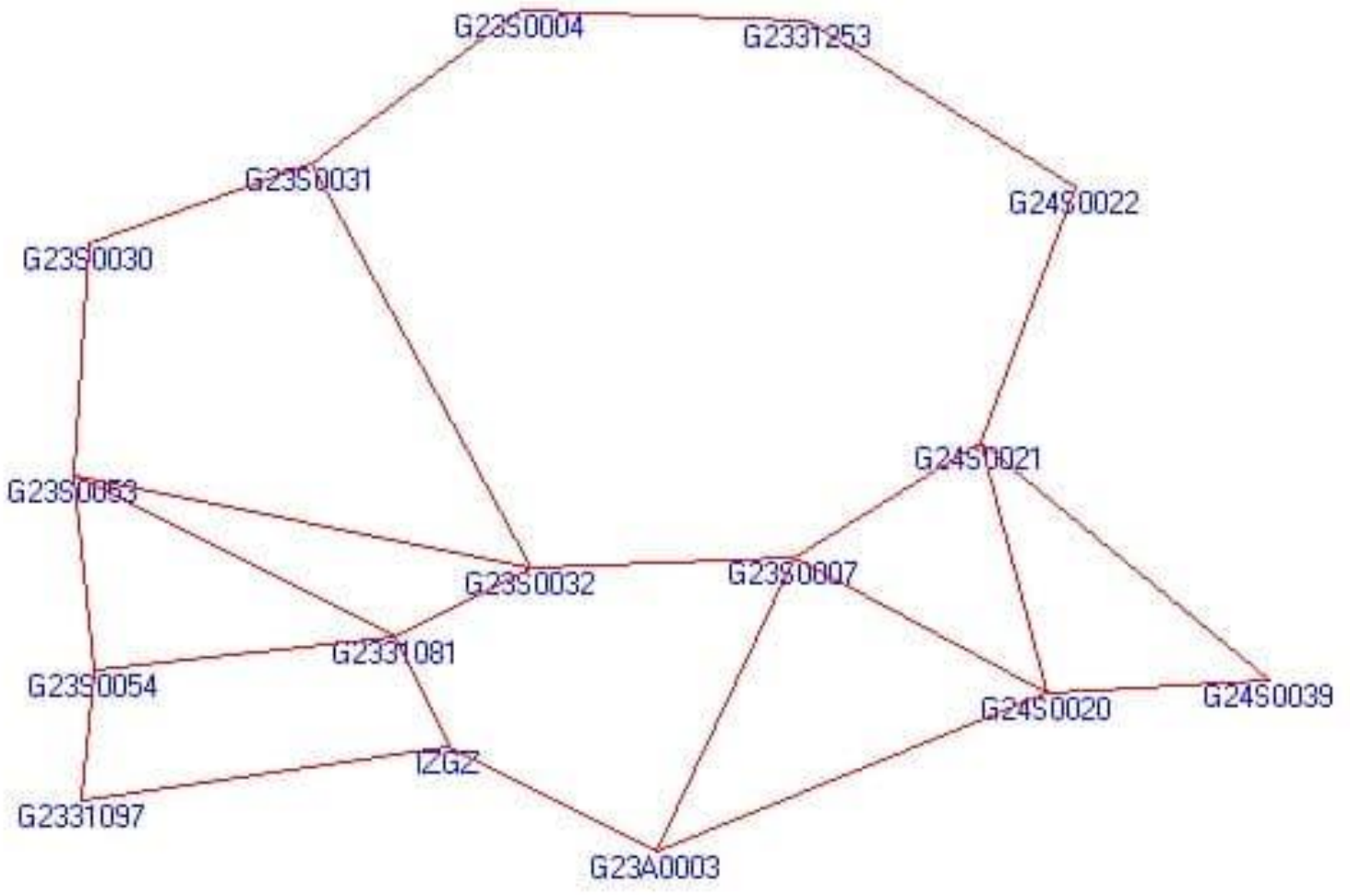
Durulan 4 -> 13, 12, 11

Durulan 13 -> 12, 14, 15

Durulan 14 -> 16, 15, 7

2-a)

1. soruda 16 nokta attığımızdan dolayı, IZDOGAP ağından 16 nokta seçerek ağ bir ağ oluşturduk. Seçtiğimiz noktaları NetCad Gis programında çizim yaparak ağımızı görselleştirerek işe başladık.



Uygulamanın en başında coğrafi koordinatlardan kartezyen koordinatlara dönüşüm işlemi yaptık.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	COĞRAFİ KOORDİNATLAR [GRS80]													
2	Nokta No	Nokta Adı	Φ0	λ0	h [m]	H [m]		Φr	λr		N(m)	a(m)	e2	e'2
3	41	G2331081	40.798224	29.873423	405.4971	369.456		0.712063338	0.52138959		6387270.996	6378137	0.00669438	0.006739497
4	43	G2331097	40.743739	29.794323	36.8425	0.6469		0.711112395	0.520009035		6387250.829			
5	44	G2331253	40.982187	29.975213	286.6603	251.0183		0.715274098	0.523166161		6387339.13			
6	46	G23A0003	40.732093	29.941499	39.5141	3.5407		0.710909134	0.522577741		6387246.519			
7	51	G23S0004	40.985149	29.90182	401.452	365.5921		0.715325794	0.521885211		6387340.228			
8	52	G23S0007	40.82352	29.975195	301.7789	265.8313		0.712504836	0.523165847		6387280.361			
9	63	G23S0030	40.911933	29.792909	307.4099	271.3494		0.714047934	0.519984356		6387313.103			
10	64	G23S0031	40.937457	29.849182	351.7663	315.7638		0.714493412	0.520966505		6387322.558			
11	65	G23S0032	40.821244	29.907949	528.9837	492.9266		0.712465113	0.521992183		6387279.518			
12	75	G23S0053	40.844296	29.789868	427.6489	391.4413		0.712867446	0.51993128		6387288.053			
13	76	G23S0054	40.783893	29.7966	229.5995	193.3845		0.711813215	0.520048776		6387265.691			
14	86	G24S0020	40.782799	30.040476	141.4262	105.5062		0.711794121	0.524305215		6387265.286			
15	87	G24S0021	40.86023	30.022062	474.9719	439.1387		0.713145547	0.52398383		6387293.954			
16	88	G24S0022	40.935391	30.045051	303.5153	267.7433		0.714457354	0.524385064		6387321.792			
17	92	G24S0039	40.788228	30.097271	148.2174	112.3935		0.711888875	0.525296475		6387267.295			
18	105	IZGZ	40.76203	29.887933	49.1155	13.0769		0.711431633	0.521642837		6387257.598			
19														
20														
21	KARTEZYEN KOORDİNATLAR [GRS80]													
22	Nokta No	Nokta Adı	X(m)	Y(m)	Z(m)									
23	41	G2331081	4193056.61683	2408527.09372	4145751.05451									
24	43	G2331097	4199564.48559	2404560.70884	4140927.92639									
25	44	G2331253	4177108.09868	2409245.64855	4161118.03008									
26	46	G23A0003	4194107.13526	2415762.47153	4139949.74623									
27	51	G23S0004	4180078.88759	2403828.65578	4161441.64517									
28	52	G23S0007	4187113.38065	2415014.67796	4147809.53324									
29	63	G23S0030	4189203.75959	2398491.15119	4155238.45123									
30	64	G23S0031	4185264.58470	2401696.89144	4157409.28722									
31	65	G23S0032	4190237.18310	2410266.86825	4147766.78159									
32	75	G23S0053	4193676.32080	2400756.34091	4149637.57413									
33	76	G23S0054	4197068.96182	2403353.32126	4144431.19368									
34	86	G24S0020	4186812.14906	2421202.37022	4144281.60696									
35	87	G24S0021	4182941.49725	2417170.42456	4151007.06161									
36	88	G24S0022	4177128.38751	2416047.42492	4157204.33963									
37	92	G24S0039	4184073.76554	2425156.48130	4144742.53727									
38	105	IZGZ	4194488.74538	2410762.65062	4142474.64760									

$$\Phi r = \Phi 0 * \frac{pi}{180}$$

$$\lambda r = \lambda 0 * \frac{pi}{180}$$

$$N\,(m) = \frac{a}{\sqrt{1 - e^2 * (\sin \Phi r)^2}}$$

$$X = (\,N + h\,) * (\cos \Phi r) * (cos\lambda r)$$

$$Y = (\,N + h\,) * (\cos \Phi r) * (sin\lambda r)$$

$$Z = \left(\frac{N}{1 + e'^2 + h}\right) * \sin \Phi r$$

Bize verilen EK_1 ve EK_2 bilgilerinden çalışmada kullanacağımız verileri çektik

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	KARTEZYEN KOORDİNATLAR [GRS80]						Noktalar arası baz vektörleri, standart sapma ve korelasyon değerleri									
2	Nokta No	Nokta Adı	X(m)	Y(m)	Z(m)		Baz (DN-BN)	dX [m]	dY [m]	dZ [m]	sigmaX [m]	sigmaY [m]	sigmaZ [m]	corrXY	corrXZ	corrYZ
3	41	G2331081	4193056.61683	2408527.09372	4145751.05451	63-64	G2350030-G2350031	-3939.1327	3205.7534	2170.7706	0.003	0.002	0.003	0.5	0.65	0.06
4	43	G2331097	4199564.48559	2404560.70884	4140927.92639	64-51	G2350031-G2350004	-5185.7415	2131.7103	4032.4205	0.004	0.003	0.004	0.52	0.49	0.64
5	44	G2331253	4177108.09868	2409245.64855	4161118.03008	64-65	G2350031-G2350032	4972.5996	8569.9617	-9642.4821	0.007	0.005	0.007	0.52	0.67	0.11
6	46	G23A0003	4194107.13526	2415762.47153	4139949.74623	63-75	G2350030-G2350053	4472.6332	2265.152	-5600.9311	0.004	0.002	0.004	0.4	0.65	-0.04
7	51	G23S0004	4180078.88759	2403828.65578	4161441.64517	75-76	G2350053-G2350054	3392.6228	2596.9818	-5206.3477	0.004	0.003	0.004	0.78	0.84	0.71
8	52	G23S0007	4187113.38065	2415014.67796	4147809.53324	75-41	G2350053-G2331081	-619.7746	7770.7473	-3886.4651	0.006	0.004	0.006	0.77	0.9	0.75
9	63	G23S0030	4189203.75959	2398491.15119	4155238.45123	75-65	G2350053-G2350032	-3439.1815	9510.5594	-1870.7795	0.006	0.004	0.006	0.75	0.87	0.75
10	64	G23S0031	4185264.58470	2401696.89144	4157409.28722	76-43	G2350054-G2331097	2495.5009	1207.4084	-3503.2524	0.002	0.002	0.002	0.72	0.82	0.49
11	65	G23S0032	4190237.18310	2410266.86825	4147766.78159	41-76	G2331081-G2350054	4012.3689	-5173.7761	-1319.9004	0.004	0.003	0.003	0.75	0.83	0.55
12	75	G23S0053	4193676.32080	2400756.34091	4149637.57413	65-41	G2350032-G2331081	2819.422	-1739.8003	-2015.6997	0.003	0.002	0.003	0.59	0.72	0.23
13	76	G23S0054	4197068.96182	2403353.32126	4144431.19368	105-43	IZGZ-G2331097	5075.703	-6201.9855	-1546.6628	0.004	0.003	0.004	0.76	0.79	0.48
14	86	G24S0020	4186812.14906	2421202.37022	4144281.60696	105-41	IZGZ-G2331081	-1432.1702	-2235.6151	3276.4847	0.002	0.002	0.002	0.66	0.78	0.37
15	87	G24S0021	4182941.49725	2417170.42456	4151007.06161	65-52	G2350032-G2350007	-3123.7484	4747.8031	42.6965	0.006	0.004	0.005	0.85	0.84	0.73
16	88	G24S0022	4177128.38751	2416047.42492	4157204.33963	105-46	IZGZ-G23A0003	-381.6609	4999.7902	-2524.8337	0.003	0.002	0.003	0.66	0.73	0.41
17	92	G24S0039	4184073.76554	2425156.48130	4144742.53727	46-52	G23A0003-G2350007	-6993.6805	-747.797	7859.7283	0.009	0.007	0.008	0.87	0.83	0.76
18	105	IZGZ	4194488.74538	2410762.65062	4142474.64760	52-86	G2350007-G2450020	-301.3012	6187.6865	-3527.8693	0.004	0.002	0.004	0.6	0.61	0.3
19						46-86	G23A0003-G2450020	-7294.9811	5439.885	4331.8835	0.009	0.004	0.008	0.59	0.73	0.29
20						87-52	G2450021-G2350007	4171.9319	-2155.7224	-3197.6071	0.003	0.003	0.002	0.77	0.68	0.56
21						87-86	G2450021-G2450020	3870.6402	4031.9636	-6725.4678	0.004	0.003	0.004	0.56	0.59	0.46
22						87-92	G2450021-G2450039	1132.3057	7986.1178	-6264.5775	0.006	0.005	0.005	0.62	0.66	0.47
23						86-92	G2450020-G2450039	-2738.3426	3954.1355	460.8897	0.003	0.002	0.003	0.43	0.75	0.15
24						88-87	G2450022-G2450021	5813.0467	1122.9059	-6197.2178	0.005	0.003	0.005	0.66	0.55	0.4
25						44-88	G2331253-G2450022	20.2528	6801.8252	-3913.6905	0.004	0.002	0.004	0.72	0.71	0.46
26						44-51	G2331253-G2350004	2970.7275	-5416.9977	323.6836	0.004	0.003	0.003	0.65	0.75	0.42

Sırasıyla K_ll , Q_ll , P_ll ve l matrislerini hesapladık

$$K_{ll} = \begin{bmatrix} \sigma_x^2 & r_{xy}\sigma_x\sigma_y & r_{xz}\sigma_x\sigma_z \\ r_{yx}\sigma_y\sigma_x & \sigma_y^2 & r_{yz}\sigma_y\sigma_z \\ r_{zx}\sigma_z\sigma_x & r_{zy}\sigma_z\sigma_y & \sigma_z^2 \end{bmatrix}$$

$$Q_{ll} = \frac{K_{ll}}{s_0^2} \qquad P_{ll} = {Q_{ll}}^{-1}$$

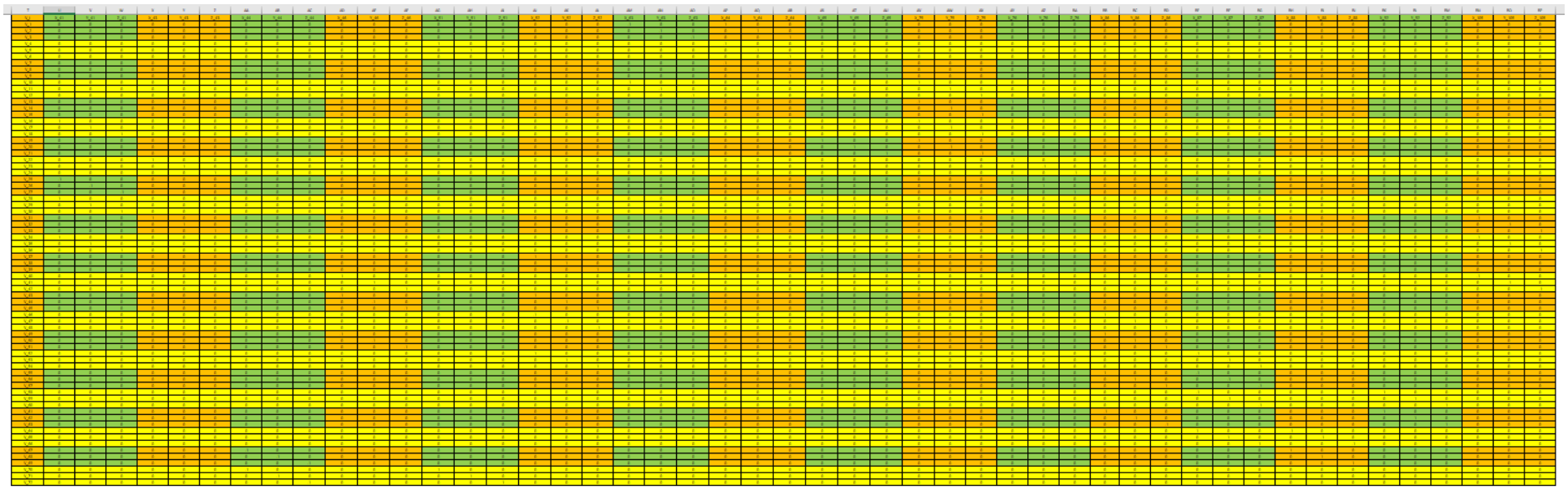
$$lx_{DN,BN} = \left[\Delta X_{DN,BN} - (X_{BN} - X_{DN})\right] * 100$$

$$ly_{DN,BN} = \left[\Delta Y_{DN,BN} - (Y_{BN} - Y_{DN})\right] * 100$$

$$lz_{DN,BN} = \left[\Delta Z_{DN,BN} - (Z_{BN} - Z_{DN})\right] * 100$$

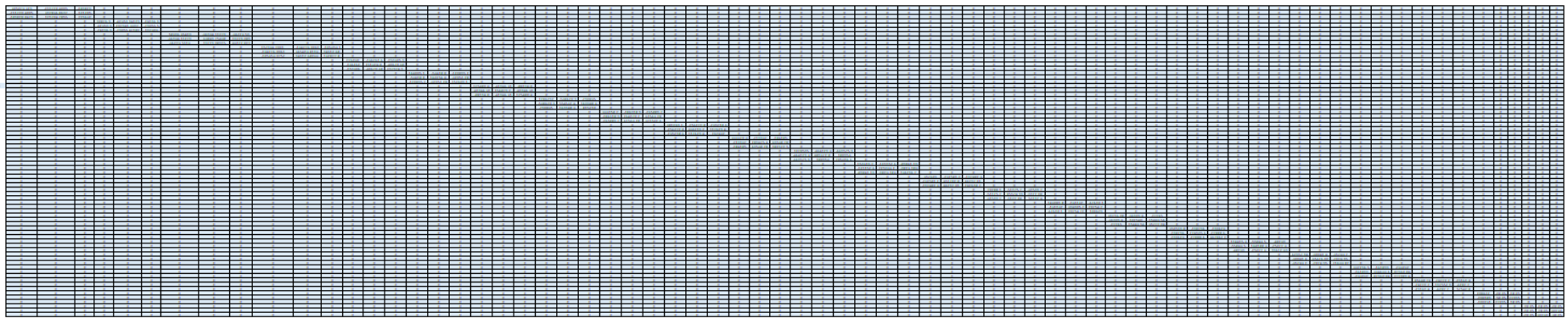
27	S_0 =	1										
28												
29												
30	Baz (DN-BN)	K_ll			Q_ll			P_ll = Q_ll ^-1			E [cm]	
31		0.000009	0.000003	0.00000585	0.000009	0.000003	0.00000585	305073.329	-211720.4	-189828.848	4.21900	
32	G23S0030-G23S0031	0.000003	0.000004	0.00000036	0.000003	0.000004	0.00000036	-211720.4005	397836.87	121704.786	1.31500002	
33		0.00000585	0.00000036	0.000009	0.00000585	0.00000036	0.000009	-189828.8479	121704.786	229631.671	-6.539000005	
34		0.000016	0.00000624	0.00000784	0.000016	0.00000624	0.00000784	90876.85078	-42359.9413	-24196.8851	-4.438999993	
35	G23S0031-G23S0004	0.00000624	0.000009	0.00000768	0.00000624	0.000009	0.00000768	-42359.94129	207941.34	-79055.4718	-5.404000023	
36		0.00000784	0.00000768	0.000016	0.00000784	0.00000768	0.000016	-24196.88507	-79055.4718	112303.1	6.254999991	
37		0.000049	0.0000182	0.00003283	0.000049	0.0000182	0.00003283	58396.35419	-36934.1128	-36223.5913	0.119999998	
38	G23S0031-G23S0032	0.0000182	0.000025	0.00000385	0.0000182	0.000025	0.00000385	-36934.11279	63849.7544	19729.0892	-1.510999991	
39		0.00003283	0.00000385	0.000049	0.00003283	0.00000385	0.000049	-36223.5913	19729.0892	43127.8267	2.353000003	
40		0.000016	0.0000032	0.0000104	0.000016	0.0000032	0.0000104	157934.7001	-134776.006	-105353.075	7.199000004	
41	G23S0030-G23S0053	0.0000032	0.000004	-0.00000032	0.0000032	0.000004	-0.00000032	-134776.0061	365413.819	94912.6803	-3.771999967	
42		0.0000104	-0.00000032	0.000016	0.0000104	-0.00000032	0.000016	-105353.0752	94912.6803	132877.752	-5.400000031	
43		0.000016	0.00000936	0.00001344	0.000016	0.00000936	0.00001344	276029.9776	-136261.622	-159305.867	-1.821999998	
44	G23S0053-G23S0054	0.00000936	0.000009	0.00000852	0.00000936	0.000009	0.00000852	-136261.6223	291324.776	-40670.6803	0.144999968	
45		0.00001344	0.00000852	0.000016	0.00001344	0.00000852	0.000016	-159305.8673	-40670.6803	217974.066	3.275000005	
46		0.000036	0.00001848	0.0000324	0.000036	0.00001848	0.0000324	164005.0982	-53418.8034	-120895.187	-7.063000032	
47	G23S0053-G2331081	0.00001848	0.000016	0.000018	0.00001848	0.000016	0.000018	-53418.80342	160256.41	-32051.2821	-0.550999998	
48		0.0000324	0.000018	0.000036	0.0000324	0.000018	0.000036	-120895.1867	-32051.2821	152609.087	5.451999992	
49		0.000036	0.000018	0.00003132	0.000036	0.000018	0.00003132	125480.4107	-41946.3087	-88194.803	-4.380000015	
50	G23S0053-G23S0032	0.000018	0.000016	0.000018	0.000018	0.000016	0.000018	-41946.30872	156879.195	-41946.3087	3.205999997	
51		0.00003132	0.000018	0.000036	0.00003132	0.000018	0.000036	-88194.80296	-41946.3087	125480.411	1.304000029	
52		0.000004	0.00000288	0.00000328	0.000004	0.00000288	0.00000328	1286291.742	-538620.914	-790834.981	-2.286999985	
53	G23S0054-G2331097	0.00000288	0.000004	0.00000196	0.00000288	0.000004	0.00000196	-538620.9138	554532.405	169948.271	2.082000014	
54		0.00000328	0.00000196	0.000004	0.00000328	0.00000196	0.000004	-790834.9809	169948.271	815210.032	1.488999987	
55		0.000016	0.000009	0.00000996	0.000016	0.000009	0.00000996	333158.1964	-186918.864	-265889.696	2.391000034	
56	G2331081-G23S0054	0.000009	0.000009	0.00000495	0.000009	0.000009	0.00000495	-186918.8638	264170.169	61563.2828	-0.364000034	
57		0.00000996	0.00000495	0.000009	0.00000996	0.00000495	0.000009	-265889.6956	61563.2828	371502.569	-3.956999986	
58		0.000009	0.00000354	0.00000648	0.000009	0.00000354	0.00000648	381269.142	-256272.765	-235218.625	-1.173000016	
59	G23S0032-G2331081	0.00000354	0.000004	0.00000138	0.00000354	0.000004	0.00000138	-256272.765	436219.24	117629.441	-2.576999995	
60		0.00000648	0.00000138	0.000009	0.00000648	0.00000138	0.000009	-235218.6249	117629.441	262432.007	2.737999963	
61		0.000016	0.00000912	0.00001264	0.000016	0.00000912	0.00001264	333370.2975	-219936.607	-184185.357	-3.720999949	
62	I2G2-G2331097	0.00000912	0.000009	0.00000576	0.00000912	0.000009	0.00000576	-219936.6065	289475.387	69538.78	-4.372000001	
63		0.00001264	0.00000576	0.000016	0.00001264	0.00000576	0.000016	-184185.3567	69538.78	182972.471	5.840999964	
64		0.000004	0.00000264	0.00000312	0.000004	0.00000264	0.00000312	1078594.565	-464129.326	-669575.91	-4.164999998	
65	I2G2-G2331081	0.00000264	0.000004	0.00000148	0.00000264	0.000004	0.00000148	-464129.3264	489372.763	180952.952	-5.81999998	
66		0.00000312	0.00000148	0.000004	0.00000312	0.00000148	0.000004	-669575.9103	180952.952	705316.618	7.778999963	
67		0.000036	0.0000204	0.0000252	0.000036	0.0000204	0.0000252	159319.7446	-121152.587	-89841.1919	5.404999984	
68	G23S0032-G23S0007	0.0000204	0.000016	0.0000146	0.0000204	0.000016	0.0000146	-121152.5868	225933.202	-9823.18271	-0.661000018	
69		0.0000252	0.0000146	0.000025	0.0000252	0.0000146	0.000025	-89841.19188	-9823.18271	136296.66	-5.514999999	
70		0.000009	0.00000396	0.00000657	0.000009	0.00000396	0.00000657	357608.9592	-232581.233	-197482.337	-5.077999968	
71	I2G2-G23A0003	0.00000396	0.000004	0.00000246	0.00000396	0.000004	0.00000246	-232581.2326	451782.757	46297.0127	-3.071000024	
72		0.00000657	0.00000246	0.000009	0.00000657	0.00000246	0.000009	-197482.3366	46297.0127	242618.7	6.766999963	
73		0.000081	0.00005481	0.00005976	0.000081	0.00005481	0.00005976	70288.10134	-51175.6712	-31599.6933	7.410999971	
74	G23A0003-G23S0007	0.00005481	0.000049	0.00004256	0.00005481	0.000049	0.00004256	-51175.67119	85574.9891	-9122.08478	-0.342999979	
75		0.00005976	0.00004256	0.000064	0.00005976	0.00004256	0.000064	-31599.69329	-9122.08478	51197.4	-5.870999962	
76		0.000016	0.0000048	0.00000976	0.000016	0.0000048	0.00000976	143081.761	-131132.075	-67610.0629	-6.961000002	
77	G23S0007-G24S0020	0.0000048	0.000004	0.0000024	0.0000048	0.000004	0.0000024	-131132.0755	394905.66	20754.717	-0.575999992	
78		0.00000976	0.0000024	0.000016	0.00000976	0.0000024	0.000016	-67610.06289	20754.717	100628.931	5.697999978	
79		0.000081	0.00002124	0.00005256	0.000081	0.00002124	0.00005256	39716.08399	-36909.42	-27264.9681	0.509999969	
80	G23A0003-G24S0020	0.00002124	0.000016	0.00000928	0.00002124	0.000016	0.00000928	-36909.42001	102539.989	15443.5628	-1.368999971	
81		0.00005256	0.00000928	0.000064	0.00005256	0.00000928	0.000064	-27264.96807	15443.5628	35777.0384	2.277000016	
82		0.000009	0.00000693	0.00000408	0.000009	0.00000693	0.00000408	350599.7585	-198795.784	-190623.295	4.849999983	
83	G24S0021-G23S0007	0.00000693	0.000009	0.00000336	0.00000693	0.000009	0.00000336	-198795.7838	274595.615	-27888.6172	2.420000019	
84		0.00000408	0.00000336	0.000004	0.00000408	0.00000336	0.000004	-190623.2953	-27888.6172	467862.2	-7.872999958	
85		0.000016	0.00000672	0.00000944	0.000016	0.00000672	0.00000944	114415.2804	-55843.4804	-48239.0147	-1.161000019	
86	G24S0021-G24S0020	0.00000672	0.000009	0.00000552	0.00000672	0.000009	0.00000552	-55843.48036	168188.334	-25077.3217	1.794000026	
87		0.00000944	0.00000552	0.000016	0.00000944	0.00000552	0.000016	-48239.01474	-25077.3217	99612.6947	-1.31499998	
88		0.000036	0.0000186	0.0000198	0.000036	0.0000186	0.0000198	62957.94206	-30041.3869	-35743.2383	3.740999996	
89	G24S0021-G24S0039	0.0000186	0.000025	0.00001175	0.0000186	0.000025	0.00001175	-30041.38691	65676.0185	-7074.95025	6.106000009	
90		0.0000198	0.00001175	0.000025	0.0000198	0.00001175	0.000025	-35743.23826	-7074.95025	71633.8713	-5.316	
91		0.000009	0.00000258	0.00000675	0.000009	0.00000258	0.00000675	332296.5003	-161898.934	-233032.482	4.092000015	
92	G24S0020-G24S0039	0.00000258	0.000004	0.0000009	0.00000258	0.000004	0.0000009	-161898.9343	334633.624	87960.8383	2.441999982	
93		0.00000675	0.0000009	0.000009	0.00000675	0.0000009	0.000009	-233032.4818	87960.8383	277089.389	-4.06100002	
94		0.000025	0.0000099	0.00001375	0.000025	0.0000099	0.00001375	85648.73821	-74772.708	-29161.3561	-6.304000022	
95	G24S0022-G24S0021	0.0000099	0.000009	0.000006	0.0000099	0.000009	0.000006	-74772.70796	197552.893	-6287.70499	-0.374000005	
96		0.00001375	0.000006	0.000025	0.00001375	0.000006	0.000025	-29161.35611	-6287.70499	57547.7951	6.021999962	
97		0.000016	0.00000576	0.00001136	0.000016	0.00000576	0.00001136	208612.0472	-208188.684	-100231.156	-3.602999998	
98	G2331253-G24S0022	0.00000576	0.000004	0.00000368	0.00000576	0.000004	0.00000368	-208188.6844	524864.101	27095.2228	4.882999991	
99		0.00001136	0.00000368	0.000016	0.00001136	0.00000368	0.000016	-100231.1561	27095.2228	127432.22	-0.004999989	
100		0.000016	0.0000078	0.000009	0.000016	0.0000078	0.000009	207476.8239	-112521.833	-160217.654	-6.141000012	
101	G2331253-G23S0004	0.0000078	0.000009	0.00000378	0.0000078	0.000009	0.00000378	-112521.8326	195933.539	30229.7461	-0.49300001	
102		0.000009	0.00000378	0.000009	0.000009	0.00000378	0.000009	-160217.6542	30229.7461	258632.272	6.851000002	
103												

Daha sonra 16 nokta için 16x3 = 48 sütunlu 24 baz gözlemi için 24x3 = 72 satırlı bir A katsayılar matrisi oluşturduk



G dönüşüm matrisi köşegen elemanları 1/ p (p=nokta sayısı) olacak şekilde 16x3 = 48 satır ve 3 sütun şeklinde oluşmuştur. Her bir gözlem için elde edilen P_ll matrisleri köşegen şeklinde yazılarak tüm ağ için P_ll ağırlık matrisi elde edilir. Burada 24 gözlem için 72x72 boyutunda bir matris kare matris oluşmuştur.

107	P(nokta sayısı) =	16		
108				
109		0.25	0	0
110		0	0.25	0
111		0	0	0.25
112		0.25	0	0
113		0	0.25	0
114		0	0	0.25
115		0.25	0	0
116		0	0.25	0
117		0	0	0.25
118		0.25	0	0
119		0	0.25	0
120		0	0	0.25
121		0.25	0	0
122		0	0.25	0
123		0	0	0.25
124		0.25	0	0
125		0	0.25	0
126		0	0	0.25
127	G	0.25	0	0
128		0	0.25	0
129		0	0	0.25
130		0.25	0	0
131		0	0.25	0
132		0	0	0.25
133		0.25	0	0
134		0	0.25	0
135		0	0	0.25
136		0.25	0	0
137		0	0.25	0
138		0	0	0.25
139		0.25	0	0
140		0	0.25	0
141		0	0	0.25
142		0.25	0	0
143		0	0.25	0
144		0	0	0.25
145		0.25	0	0
146		0	0.25	0
147		0	0	0.25
148		0.25	0	0
149		0	0.25	0
150		0	0	0.25
151		0.25	0	0
152		0	0.25	0
153		0	0	0.25
154		0.25	0	0
155		0	0.25	0
156		0	0	0.25



Burada N matrisinin MoorePenrose tersi alınarak Q_xx matrisine ulaşılır.

$$N = A^T P_{ll} A$$

$$Q_{xx} = N^+ = (N + GG^T)^{-1} - GG^T$$

X = N_i * A_T * P_ll * l (cm)	v = A * x - l (cm)
-2.117716865	0.154105045
-2.308099137	0.197231838
3.81877992	0.129823332
-1.496984662	1.146434218
-0.633389413	0.417407822
1.84821721	-0.032406617
5.017250406	-1.927871494
-0.448639838	-1.077992696
-2.884469684	0.936130683
-3.350383327	-0.142467913
0.252938786	-0.176651885
2.073878731	-0.17162356
-2.259146278	-1.022439513
-1.746289249	-0.525189153
3.606140755	-1.080386738
3.311890149	1.228436613
-0.70685176	0.463481619
-4.627459778	0.145679464
-3.339685538	-0.111298536
1.728071094	-0.334108973
3.792724055	1.147577575
1.033419498	-0.082391719
3.240302952	-0.114619483
-2.616452618	-0.056496509
-0.774451998	0.599123874
0.651310266	0.071329227
0.672678067	0.553933798
3.716846553	-0.170264851
-2.220580759	-0.382409408
-1.778899536	0.40810189
0.872407042	0.260304488
-2.600769944	0.257252417
0.415713732	0.166325054
-3.360857963	0.083572333
-1.260913974	0.030542673
1.864543499	0.198887766
-2.288651325	-1.318657837
-3.665561794	-0.697162008
3.079715814	0.214862154
2.314492734	-0.236094158
4.863404779	-0.15741936
-2.777807203	-0.534013423
0.757860784	-0.748726495
1.373709819	-0.616790567
-2.328195154	-0.830338547
1.963710799	0.28825189
3.48135817	0.021937778
-4.159107809	0.794003298
	-0.520474606
	-0.144852789
	-2.486335248
	0.75054149
	0.538710015
	0.165824366
	0.08879338
	0.610647793
	0.099827665
	-0.694487888
	-1.066728396
	-0.091910969
	0.026718732
	0.192623811
	-0.131738633
	1.700855963
	0.845033433
	-0.164476945
	0.900242326
	0.429044626
	0.111662471
	-1.135396672
	-0.804649401
	-0.360389562

n	72	
u	48	
f	27	
V_T*P*V	2134615.62	cm_2
V_T*P*l	-2134615.63	cm_2
l_T*P*l - X_T*A_T*P*l	2134615.63	cm_2
m_o = ((V_T*P*V)/(n-u))^1/2	281.1758131	cm
Test Büyüklüğü	T = (m_0)^2 /(s_0)^2	79059.83789
Sınır Değer	f	1.904822988

Ardından X ve m_0 değerlerini hesaplayıp test büyüklüğü ve sınır değerlerini hesapladık

$$x = N^{+} A^{T} P_{ll} l$$

$$v = Ax - l$$

$$m_0 = \sqrt{\frac{V^T P_{ll} V}{n - u}}$$

Test büyüklüğü tablo değerinden büyük (T > q), dengeleme modeli geçersizdir. Bu durum, ölçülerde kaba hata olması ya da fonksiyonel ve stokastik modellerin yanlış kurulması gibi nedenlerden kaynaklanabilir. Bu durumda uyuşumsuz ölçüler testi ile uyuşumsuz ölçülerin ayıklanması gerekmektedir. Test sonucunda uyuşumsuz ölçülerden arınmış ölçülerle yeni bir dengeleme işlemi yapılır ve model hipotezi testi yenilenir.

Uyuşumsuz Ölçüler Testi, Q_vv düzeltmeleri ters ağırlık matris değerlerini hesapladık

$$Q_{vv} = Q_{ll} - AQ_{xx}A^T$$

$$Q_{ll} = P_{ll}^{-1}$$

σ_0^2 Bilinmiyorsa (Tau-Dağılımı, Pope Testi)

$$T_i = \frac{\left|\underline{e}_i^T \underline{P}\, \underline{v}\right|}{m_0 \sqrt{\underline{e}_i^T \underline{P}\, \underline{Q}_{vv} \underline{P}\, \underline{e}_i}} = \frac{\left|(\underline{P}\, \underline{v})_i\right|}{m_0 \sqrt{(\underline{P}\, \underline{Q}_{vv} \underline{P})_{ii}}} \sim \tau_f \qquad \text{Test büyüklüğü}$$

$$q = \tau_{(f,\alpha_0)} \qquad \text{Sınır değer}$$

$$\tau_{(f,\alpha_0)} = \sqrt{\frac{f\, t^2_{(f-1,\alpha_0)}}{f - 1 + t^2_{(f-1,\alpha_0)}}} \qquad t^2_{(f-1,\alpha_0)} = F_{(1,\, f-1,\, 2\alpha_0)}$$

511						
512						
513		39843.59017	-25745.3951	-23807.93299		-19388.87817
514	Q_DELTA_DELTA_1	-25745.3951	53831.89941	8936.282303		61639.03584
515		-23807.93299	8936.282302	30451.54387		24562.02403
516		20127.25684	-13267.81426	-9838.854882		87287.09973
517	Q_DELTA_DELTA_2	-13267.81426	32646.26324	-943.8130415		40795.37586
518		-9838.854882	-943.8130411	16799.63235		-64377.87285
519		36521.51261	-23263.49924	-22233.93846		-106675.978
520	Q_DELTA_DELTA_3	-23263.49924	43530.57849	10485.42576		20843.66002
521		-22233.93846	10485.42576	27312.85632		88939.89693
522		39843.59017	-25745.3951	-23807.93299		19388.87826
523	Q_DELTA_DELTA_4	-25745.3951	53831.89941	8936.282303		-61639.0359
524		-23807.93299	8936.282303	30451.54387		-24562.02409
525		109899.5204	-53583.15098	-70341.35063		-38548.88356
526	Q_DELTA_DELTA_5	-53583.15098	106919.5465	-4860.894098		30258.71809
527		-70341.35063	-4860.894099	91158.17208		-51255.8763
528		104624.8598	-42033.96581	-72464.83687		159099.2878
529	Q_DELTA_DELTA_6	-42033.96581	104260.1543	-13038.94817		3985.072996
530		-72464.83687	-13038.94817	91421.64304	P*V	-141135.2438
531		80068.4976	-35168.59791	-52346.20548		-101161.5259
532	Q_DELTA_DELTA_7	-35168.59791	91848.00503	-11352.62116		-95882.82707
533		-52346.20548	-11352.62116	69257.72996		167829.0959
534		141962.7416	-78840.45361	-87235.3099		436.0792144
535	Q_DELTA_DELTA_8	-78840.45361	104913.0041	23245.37812		-28783.79872
536		-87235.3099	23245.37813	97002.80282		-377.6509389
537		161670.9118	-88424.71396	-109195.945		38984.96221
538	Q_DELTA_DELTA_9	-88424.71396	135069.0416	17577.59697		-59042.51669
539		-109195.945	17577.59697	138623.5754		50878.22578
540		111202.1577	-62571.75471	-69398.44953		-62908.7827
541	Q_DELTA_DELTA_10	-62571.75471	124275.4483	6363.426806		-75175.30001
542		-69398.44953	6363.426805	86614.50213		102165.8573
543		141962.7416	-78840.45362	-87235.30992		-436.0784112
544	Q_DELTA_DELTA_11	-78840.45362	104913.0041	23245.37814		28783.79848
545		-87235.30992	23245.37814	97002.80283		377.6503878
546		170662.3263	-95644.14974	-105053.1424		-57205.54254
547	Q_DELTA_DELTA_12	-95644.14974	135651.2502	26057.56513		12147.70985
548		-105053.1424	26057.56513	121241.2628		89847.61198
549		54277.62504	-38726.88587	-30221.43347		-144928.7213
550	Q_DELTA_DELTA_13	-38726.88587	74066.94417	1215.104706		136.1329232
551		-30221.43347	1215.104706	43376.68102		154603.1356
552		48538.86747	-34112.85194	-27087.46498		57641.62127
553	Q_DELTA_DELTA_14	-34112.85194	65872.98718	2807.227506		-40931.50859
554		-27087.46498	2807.227507	37548.22117		-90225.26261
555		44089.70641	-30611.77287	-22455.60711		5176.550875
556	Q_DELTA_DELTA_15	-30611.77287	53288.93783	-2501.946546		-6890.846495
557		-22455.60711	-2501.946546	33161.67198		-13225.23125
558		70316.78709	-48189.46353	-34922.46278		-15315.7713
559	Q_DELTA_DELTA_16	-48189.46353	114360.7683	2856.483992		-12656.40216
560		-34922.46278	2856.483991	58253.19314		60866.28697
561		27339.77256	-21237.29295	-17388.63263		52465.07045
562	Q_DELTA_DELTA_17	-21237.29295	52597.65943	5026.470424		-34040.66216
563		-17388.63263	5026.470424	23834.7628		-77000.03135
564		78201.13171	-47294.6104	-39218.4469		124436.3985
565	Q_DELTA_DELTA_18	-47294.6104	96471.97318	-789.7124143		-5901.688156
566		-39218.4469	-789.7124142	69975.63479		-80511.61686
567		67131.32261	-36585.82311	-31638.07097		-28756.96674
568	Q_DELTA_DELTA_19	-36585.82311	92570.46738	-6784.280773		95241.89301
569		-31638.07097	-6784.280773	59558.14558		-9652.613676
570		42639.76962	-20606.62278	-24833.03024		-8392.332093
571	Q_DELTA_DELTA_20	-20606.62278	45278.29905	-733.8170423		-48544.82898
572		-24833.03024	-733.8170423	42807.52663		25786.35789
573		42639.76962	-20606.62278	-24833.03024		8392.332042
574	Q_DELTA_DELTA_21	-20606.62278	45278.29904	-733.8170424		48544.82904
575		-24833.03024	-733.8170419	42807.52663		-25786.35784
576		20127.25684	-13267.81426	-9838.854882		87287.09977
577	Q_DELTA_DELTA_22	-13267.81426	32646.26324	-943.8130419		40795.37583
578		-9838.854882	-943.8130419	16799.63235		-64377.87287
579		20127.25684	-13267.81426	-9838.854882		87287.09985
580	Q_DELTA_DELTA_23	-13267.81426	32646.26324	-943.8130418		40795.37576
581		-9838.854882	-943.8130419	16799.63235		-64377.8729
582		20127.25683	-13267.81426	-9838.854881		-87287.09984
583	Q_DELTA_DELTA_24	-13267.81426	32646.26324	-943.813043		-40795.37575
584		-9838.854881	-943.8130424	16799.63235		64377.87295

HİPOTEZ TESTLERİ						
L_İ	V	T_i	Ai_T * QΔΔi_-1 * Ai=A	Ti= A/(3*m0 2)	T_f	SONUÇ
1	0.15410504	12138.96668				
2	0.19723184	44856.51139	104842.5286	0.586351339	1.770883351	UYUŞUMLU
3	0.12982333	13443.6939				
4	1.14643422	38841.15746				
5	0.41740782	23119.44921	791238.1954	1.610804373	1.770883351	UYUŞUMLU
6	-0.03240662	26171.96417				
7	-1.92787149	63942.67738				
8	-1.0779927	13640.2084	413128.4429	1.163943036	1.770883351	UYUŞUMLU
9	0.93613068	46103.08501				
10	-0.14246791	12138.96674				
11	-0.17665189	44856.51143	104842.5287	0.58635134	1.770883351	UYUŞUMLU
12	-0.17162356	13443.69393				
13	-1.02243951	40082.93447				
14	-0.52518915	31033.36609	197498.2971	0.80476829	1.770883351	UYUŞUMLU
15	-1.08038674	48539.05003				
16	1.22843661	161411.8762				
17	0.46348162	4035.945268	294869.4494	0.98334082	1.770883351	UYUŞUMLU
18	0.14567946	133847.3553				
19	-0.11129854	89783.39366				
20	-0.33410897	91143.45762	461609.0266	1.230343345	1.770883351	UYUŞUMLU
21	1.14757757	138532.3454				
22	-0.08239172	515.3501195				
23	-0.11461948	29242.37055	17601.32163	0.240249127	1.770883351	UYUŞUMLU
24	-0.05649651	368.9202683				
25	0.59912387	49165.77246				
26	0.07132923	68060.09887	103906.4174	0.583727782	1.770883351	UYUŞUMLU
27	0.5539338	59415.57601				
28	-0.17026485	65798.75771				
29	-0.38240941	83122.3178	188782.809	0.786810959	1.770883351	UYUŞUMLU
30	0.40810189	94308.51269				
31	0.26030449	515.3491704				
32	0.25725242	29242.3703	17601.32184	0.240249128	1.770883351	UYUŞUMLU
33	0.16632505	368.91973				
34	0.08357233	74123.64115				
35	0.03054267	14033.18066	74137.3754	0.493069094	1.770883351	UYUŞUMLU
36	0.19888777	98125.42929				
37	-1.31865784	105904.5659				
38	-0.69716201	116.2051002	663213.624	1.474741487	1.770883351	UYUŞUMLU
39	0.21486215	100994.1603				
40	-0.23609416	39831.88071				
41	-0.15741936	32950.44135	278406.6817	0.95549629	1.770883351	UYUŞUMLU
42	-0.53401342	54836.86823				
43	-0.7487265	3409.250365				
44	-0.61679057	4989.314873	14420.0855	0.217456852	1.770883351	UYUŞUMLU
45	-0.83033855	7553.90102				
46	0.28825189	12738.49695				
47	0.02193778	13424.51498	72935.88651	0.489057374	1.770883351	UYUŞUMLU
48	0.7940033	46077.24272				
49	-0.52047461	27209.30912				
50	-0.14485279	24486.7425	265942.3937	0.933862561	1.770883351	UYUŞUMLU
51	-2.48633525	37286.02828				
52	0.75054149	109144.978				
53	0.53871002	5749.454534	270042.8689	0.941034476	1.770883351	UYUŞUMLU
54	0.16582437	66800.8175				
55	0.08879338	23369.82619				
56	0.61064779	90889.57078	99753.71094	0.571944264	1.770883351	UYUŞUMLU
57	0.09982766	7388.653733				
58	-0.69448789	5435.504896				
59	-1.0667284	32399.46454	80145.67312	0.512659747	1.770883351	UYUŞUMLU
60	-0.09191097	16734.00442				
61	0.02671873	5435.504864				
62	0.19262381	32399.46458	80145.6732	0.512659747	1.770883351	UYUŞUMLU
63	-0.13173863	16734.00439				
64	1.70085596	38841.15748				
65	0.84503343	23119.44919	791238.1957	1.610804374	1.770883351	UYUŞUMLU
66	-0.16447694	26171.96418				
67	0.90024233	38841.15751				
68	0.42904463	23119.44915	791238.1962	1.610804374	1.770883351	UYUŞUMLU
69	0.11166247	26171.96419				
70	-1.13539667	38841.1575				
71	-0.8046494	23119.44915	791238.1958	1.610804374	1.770883351	UYUŞUMLU
72	-0.36038956	26171.96421				

2-b)

Sonuç Denetimleri				
DN-BN	delta X,Y,Z	v = A * x - l (cm)	l_i + V_i (m)	X_BN - X_DN
	-3939.1327	0.154105045	-3939.131159	-3939.131159
63-64	3205.7534	0.197231838	3205.755372	3205.755372
	2170.7706	0.129823332	2170.771898	2170.771898
	-5185.7415	1.146434218	-5185.730036	-5185.730036
64-51	2131.7103	0.417407822	2131.714474	2131.714474
	4032.4205	-0.032406617	4032.420176	4032.420176
	4972.5996	-1.927871494	4972.580321	4972.580321
64-65	8569.9617	-1.077992696	8569.95092	8569.95092
	-9642.4821	0.936130683	-9642.472739	-9642.472739
	4472.6332	-0.142467913	4472.631775	4472.631775
63-75	2265.152	-0.176651885	2265.150233	2265.150233
	-5600.9311	-0.17162356	-5600.932816	-5600.932816
	3392.6228	-1.022439513	3392.612576	3392.612576
75-76	2596.9818	-0.525189153	2596.976548	2596.976548
	-5206.3477	-1.080386738	-5206.358504	-5206.358504
	-619.7746	1.228436613	-619.7623156	-619.7623156
75-41	7770.7473	0.463481619	7770.751935	7770.751935
	-3886.4651	0.145679464	-3886.463643	-3886.463643
	-3439.1815	-0.111298536	-3439.182613	-3439.182613
75-65	9510.5594	-0.334108973	9510.556059	9510.556059
	-1870.7795	1.147577575	-1870.768024	-1870.768024
	2495.5009	-0.082391719	2495.500076	2495.500076
76-43	1207.4084	-0.114619483	1207.407254	1207.407254
	-3503.2524	-0.056496509	-3503.252965	-3503.252965
	4012.3689	0.599123874	4012.374891	4012.374891
41-76	-5173.7761	0.071329227	-5173.775387	-5173.775387
	-1319.9004	0.553933798	-1319.894861	-1319.894861
	2819.422	-0.170264851	2819.420297	2819.420297
65-41	-1739.8003	-0.382409408	-1739.804124	-1739.804124
	-2015.6997	0.40810189	-2015.695619	-2015.695619
	5075.703	0.260304488	5075.705603	5075.705603
105-43	-6201.9855	0.257252417	-6201.982927	-6201.982927
	-1546.6628	0.166325054	-1546.661137	-1546.661137
	-1432.1702	0.083572333	-1432.169364	-1432.169364
105-41	-2235.6151	0.030542673	-2235.614795	-2235.614795
	3276.4847	0.198887766	3276.486689	3276.486689
	-3123.7484	-1.318657837	-3123.761587	-3123.761587
65-52	4747.8031	-0.697162008	4747.796128	4747.796128
	42.6965	0.214862154	42.69864862	42.69864862
	-381.6609	-0.236094158	-381.6632609	-381.6632609
105-46	4999.7902	-0.15741936	4999.788626	4999.788626
	-2524.8337	-0.534013423	-2524.83904	-2524.83904
	-6993.6805	-0.748726495	-6993.687987	-6993.687987
46-52	-747.797	-0.616790567	-747.8031679	-747.8031679
	7859.7283	-0.830338547	7859.719997	7859.719997
	-301.3012	0.28825189	-301.2983175	-301.2983175
52-86	6187.6865	0.021937778	6187.686719	6187.686719
	-3527.8693	0.794003298	-3527.86136	-3527.86136
	-7294.9811	-0.520474606	-7294.986305	-7294.986305
46-86	5439.885	-0.144852789	5439.883551	5439.883551
	4331.8835	-2.486335248	4331.858637	4331.858637
	4171.9319	0.75054149	4171.939405	4171.939405
87-52	-2155.7224	0.538710015	-2155.717013	-2155.717013
	-3197.6071	0.165824366	-3197.605442	-3197.605442
	3870.6402	0.08879338	3870.641088	3870.641088
87-86	4031.9636	0.610647793	4031.969706	4031.969706
	-6725.4678	0.099827665	-6725.466802	-6725.466802
	1132.3057	-0.694487888	1132.298755	1132.298755
87-92	7986.1178	-1.066728396	7986.107133	7986.107133
	-6264.5775	-0.091910069	-6264.578419	-6264.578419
	-2738.3426	0.026718732	-2738.342333	-2738.342333
86-92	3954.1355	0.192623811	3954.137426	3954.137426
	460.8897	-0.131738633	460.8883826	460.8883826
	5813.0467	1.700855963	5813.063709	5813.063709
88-87	1122.9059	0.845033433	1122.91435	1122.91435
	-6197.2178	-0.164476045	-6197.219445	-6197.219445
	20.2528	0.900242326	20.26180242	20.26180242
44-88	6801.8252	0.429044626	6801.82949	6801.82949
	-3913.6905	0.111662471	-3913.689383	-3913.689383
	2970.7275	-1.135396672	2970.716146	2970.716146
44-51	-5416.9977	-0.804649401	-5417.005746	-5417.005746
	323.6836	-0.360389562	323.6799961	323.6799961

	YAKLAŞIK KOORDİNATLAR KÜMESİ			DENGELİ KOORDİNATLAR			X = N_+ * A_T * P_II * l (cm)	
Nokta No	X(m)	Y(m)	Z(m)	X(m)	Y(m)	Z(m)	-2.117716865	Nokta No
41	4193056.61683	2408527.09372	4145751.05451	4193056.596	2408527.071	4145751.093	-2.308099137	41
43	4199564.48559	2404560.70884	4140927.92639	4199564.471	2404560.703	4140927.945	3.81877992	43
44	4177108.09868	2409245.64855	4161118.03008	4177108.149	2409245.644	4161118.001	-1.496984662	44
46	4194107.13526	2415762.47153	4139949.74623	4194107.102	2415762.474	4139949.767	-0.633389413	46
51	4180078.88759	2403828.65578	4161441.64517	4180078.865	2403828.638	4161441.681	1.84821721	51
52	4187113.38065	2415014.67796	4147809.53324	4187113.414	2415014.671	4147809.487	5.017250406	52
63	4189203.75959	2398491.15119	4155238.45123	4189203.726	2398491.168	4155238.489	-0.448639838	63
64	4185264.58470	2401696.89144	4157409.28722	4185264.595	2401696.924	4157409.261	-2.884469684	64
65	4190237.18310	2410266.86825	4147766.78159	4190237.175	2410266.875	4147766.788	-3.350383327	65
75	4193676.32080	2400756.34091	4149637.57413	4193676.358	2400756.319	4149637.556	0.252938786	75
76	4197068.96182	2403353.32126	4144431.19368	4197068.971	2403353.295	4144431.198	2.073878731	76
86	4186812.14906	2421202.37022	4144281.60696	4186812.115	2421202.358	4144281.626	-2.259146278	86
87	4182941.49725	2417170.42456	4151007.06161	4182941.474	2417170.388	4151007.092	-1.746289249	87
88	4177128.38751	2416047.42492	4157204.33963	4177128.411	2416047.474	4157204.312	3.606140755	88
92	4184073.76554	2425156.48130	4144742.53727	4184073.773	2425156.495	4144742.514	3.311890149	92
105	4194488.74538	2410762.65062	4142474.64760	4194488.765	2410762.685	4142474.606	-0.70685176	105
							-4.627459778	
				STANDART SAPMA			-3.339685538	
				6874.675652	7760.674404	7043.632787	1.728071094	
							3.792724055	
							1.033419498	
							3.240302952	
							-2.616452618	
							-0.774451998	
							0.651310266	
							0.672678067	
							3.716846553	
							-2.220580759	
							-1.778899536	
							0.872407042	
							-2.600769944	
							0.415713732	
							-3.360857963	
							-1.260913974	
							1.864543499	
							-2.288651325	
							-3.665561794	
							3.079715814	
							2.314492734	
							4.863404779	
							-2.777807203	
							0.757860784	
							1.373709819	
							-2.328195154	
							1.963710799	
							3.48135817	
							-4.159107809	

Uygulamanın son kısmında sonuç denetimleri, dengeli koordinatlar ve dengeli koordinatların standart sapma değerini hesapladık.

3-a)

Çalışmaya ilk olarak matris kondisyonunu artırmak için verilen koordinatları indirgeyerek başladık. Daha sonra N = h – H formülünden geoit yüksekliği değerlerimizi hesapladık.

	A	B	C	D	E	F	G	H	I	J	K	L
1	KARTEZYEN KOORDİNATLAR [GRS80]											
2	Nokta No	Nokta Adı	X(m)	Y(m)	Z(m)	h [m]	H [m]	N = h - H (m)	X(m)	Y(m)	x_0	4188245.24746
3	41	G2331081	-4811.36937	1588.10510	4145751.05451	405.4971	369.456	36.0411	4193056.61683	2408527.09372	y_0	2410115.19882
4	43	G2331097	-11319.23813	5554.48998	4140927.92639	36.8425	0.6469	36.1956	4199564.48559	2404560.70884		
5	44	G2331253	11137.14878	869.55027	4161118.03008	286.6603	251.0183	35.642	4177108.09868	2409245.64855		
6	46	G23A0003	-5861.88780	-5647.27271	4139949.74623	39.5141	3.5407	35.9734	4194107.13526	2415762.47153		
7	51	G23S0004	8166.35987	6286.54304	4161441.64517	401.452	365.5921	35.8599	4180078.88759	2403828.65578		
8	52	G23S0007	1131.86681	-4899.47914	4147809.53324	301.7789	265.8313	35.9476	4187113.38065	2415014.67796		
9	63	G23S0030	-958.51213	11624.04763	4155238.45123	307.4099	271.3494	36.0605	4189203.75959	2398491.15119		
10	64	G23S0031	2980.66276	8418.30738	4157409.28722	351.7663	315.7638	36.0025	4185264.58470	2401696.89144		
11	65	G23S0032	-1991.93564	-151.66943	4147766.78159	528.9837	492.9266	36.0571	4190237.18310	2410266.86825		
12	75	G23S0053	-5431.07334	9358.85791	4149637.57413	427.6489	391.4413	36.2076	4193676.32080	2400756.34091		
13	76	G23S0054	-8823.71436	6761.87756	4144431.19368	229.5995	193.3845	36.215	4197068.96182	2403353.32126		
14	86	G24S0020	1433.09840	-11087.17140	4144281.60696	141.4262	105.5062	35.92	4186812.14906	2421202.37022		
15	87	G24S0021	5303.75021	-7055.22574	4151007.06161	474.9719	439.1387	35.8332	4182941.49725	2417170.42456		
16	88	G24S0022	11116.85995	-5932.22610	4157204.33963	303.5153	267.7433	35.772	4177128.38751	2416047.42492		
17	92	G24S0039	4171.48192	-15041.28248	4144742.53727	148.2174	112.3935	35.8239	4184073.76554	2425156.48130		
18	105	IZGZ	-6243.49792	-647.45180	4142474.64760	49.1155	13.0769	36.0386	4194488.74538	2410762.65062		

3. derece bir yüzey polinomu oluşturduk ve bu polinoma bağlı olarak A katsayılar matrisimizi oluşturduk. Daha sonra X matrisinin hesabı için n ve Qxx matrislerini oluşturduk. Ardından v düzeltmeler matrisimizi hesapladık.

$$\underline{n} = \underline{A}^T \underline{l}$$

$$Q_{xx} = N^{-1} = (A^T A)^{-1}$$

$$\underline{X} = \underline{N}^{-1} \underline{n}$$

$$v = AX - l$$

n= 3 için ;

N(x, y) = a_0 + a_1 y + a_2 x + a_3 x^2 + a_4 xy + a_5 y^2 + a_6 x^3 + a_4 x^2 y + a_8 xy^2 + a_9 y^3

Nokta No	a_0	a_1 y	a_2 x	a_3 x^2	a_4 xy	a_5 y^2	a_6 x^3	a_7 x^2 y	a_8 xy^2	a_9 y^3	L (m)
41	1.0000	1588.1051	-4811.3694	23149275.2206	-7640960.2144	2522077.7948	-111379713748.5000	36763481937.8493	-12134647851.9997	4005324597.4082	36.0411
43	1.0000	5554.4900	-11319.2381	128125151.8578	-62872594.7283	30852358.8893	-1450279104400.6400	711669871619.5020	-349225197159.7070	171369118175.1220	36.1956
44	1.0000	869.5503	11137.1488	124036082.9339	9684310.6794	756117.6644	1381408309646.3000	1078555608862.3110	8420994923.6793	657482315.9652	35.642
46	1.0000	-5647.2727	-5861.8878	34361728.5871	33103679.0312	31891689.1105	-201424597613.1620	-194050052268.7560	-186945503338.2990	-180101065729.2000	35.9734
51	1.0000	6286.5430	8166.3599	66689433.5161	51338172.7632	39520623.3388	544609913577.6170	419245993820.6950	322739632446.3930	248448099413.8750	35.8599
52	1.0000	-4899.4791	1131.8668	1281122.4742	-5545557.8267	24004895.8862	1450060007.2519	-62768328 43.5614	27170344916.0544	-117611486757.1500	35.9476
63	1.0000	11624.0476	-958.5121	918745.5046	-11141790.6561	135118483.2028	-880628711.0724	10679541500.7709	-129512705221.4810	1570623683851.5500	36.0605
64	1.0000	8418.3074	2980.6628	8884350.4851	25092135.2915	70867899.0705	26481252632.2551	74791193216.5821	211233307594.6250	596587757440.3090	36.0025
65	1.0000	-151.6694	-1991.9356	3967807.5964	302115.7519	23003.6173	-7903617366.3928	-601795133.8521	-45821725.2100	-3488945.6280	36.0571
75	1.0000	9358.8579	-5431.0733	29496557.6312	-50828643.6699	87588221.2977	-160197967791.2400	276054091575.8920	-475698053642.5900	819725717331.5160	36.2076
76	1.0000	6761.8776	-8823.7144	77857935.1179	-59664876.0924	45722988.0773	-68699618018 8.3180	526465824000.9850	-403446586508.0350	309173246855.7750	36.215
86	1.0000	-11087.1714	1433.0984	2053771.0223	-15889007.5932	122925369.7500	2943255964.7289	-22770511349.4835	176164150631.2960	-1362894644364.2300	35.92
87	1.0000	-7055.2257	5303.7502	28129766.2834	-37419155.0189	49776210.3041	149193253815.5170	-198461851266.2380	264000585822.2370	-351182400394.8570	35.8332
88	1.0000	-5932.2261	11116.8599	123584575.1340	-65947726.7904	35191306.5534	1373872413668.0800	-733131642708.1780	391216826389.9980	-208762787383.3070	35.772
92	1.0000	-15041.2825	4171.4819	17401261.4037	-62744437.9278	226240178.7748	72589047319.7510	-261737288357.1210	943756815195.1530	-3402942438266.7200	35.8239
105	1.0000	-647.4518	-6243.4979	38981266.2848	4042363.9943	419193.8390	-243379454992.7720	-25238491192.9395	-2617235862.0616	-271407807.4357	36.0386

0.787803455	0.000133227	0.00016694	-4.49839E-09	9.30978E-10	-6.78289E-09	-1.35621E-12	-2.02674E-12	-2.42011E-12	-1.18124E-12
0.000133227	4.18343E-08	4.28285E-08	-2.6586E-13	9.20889E-13	-1.22134E-12	-3.74043E-16	-6.54434E-16	-6.86872E-16	-3.49671E-16
0.00016694	4.28285E-08	6.73474E-08	-2.6988E-13	1.20291E-12	-1.31504E-12	-5.78329E-16	-7.82592E-16	-9.58329E-16	-3.84797E-16
-4.49839E-09	-2.6586E-13	-2.6988E-13	7.78654E-17	5.30545E-17	3.85317E-17	-8.68347E-22	-2.21795E-21	3.26514E-21	2.52823E-21
9.30978E-10	9.20889E-13	1.20291E-12	5.30545E-17	1.3782E-16	1.07732E-17	-1.3322E-20	-2.26163E-20	-2.33158E-20	-8.86449E-21
-6.78289E-09	-1.22134E-12	-1.31504E-12	3.85317E-17	1.07732E-17	7.87604E-17	1.08716E-20	1.64708E-20	1.69886E-20	1.04581E-20
-1.35621E-12	-3.74043E-16	-5.78329E-16	-8.68347E-22	-1.3322E-20	1.08716E-20	5.44114E-24	7.35258E-24	7.91312E-24	3.25209E-24
-2.02674E-12	-6.54434E-16	-7.82592E-16	-2.21795E-21	-2.26163E-20	1.64708E-20	7.35258E-24	1.2531E-23	1.24729E-23	5.55744E-24
-2.42011E-12	-6.86872E-16	-9.58329E-16	3.26514E-21	-2.33158E-20	1.69886E-20	7.91312E-24	1.24729E-23	1.6557E-23	6.49879E-24
-1.18124E-12	-3.49671E-16	-3.84797E-16	2.52823E-21	-8.86449E-21	1.04581E-20	3.25209E-24	5.55744E-24	6.49879E-24	3.13464E-24

Q_xx = (A_T * A)^-1

A_T * L	X = Q_xx * A_T * L	
575.59	36.00963334	a_0
10519.08987	1.02377E-05	a_1
-15144.80187	-1.2459E-05	a_2
25480935356	-8.70405E-10	a_3
-9234832407	-1.10107E-09	a_4
32491748767	-2.27302E-10	a_5
2.34481E+13	-3.91167E-14	a_6
2.64326E+13	-1.75275E-14	a_7
2.76429E+13	-1.45062E-14	a_8
-6.73572E+13	-1.4327E-14	a_9

V = A * X - L	f = n-u	6
0.03625842	n	16
0.009485367	u	10
0.062923291	m_0 = (V_T * V / n-u)^1/2 (m)	0.053729405
-0.005583114		0.047689303
-0.04810144		1.09895E-05
-0.001349022		1.39435E-05
0.040057791		4.74116E-10
-0.009246726	m_x=m_ai = m_o * (Q xx)^1/2	6.30765E-10
-0.027672959		4.76833E-10
-0.027520786		1.25331E-13
-0.019603435		1.90197E-13
-0.036707461		2.18626E-13
0.042371964		9.51275E-14
-0.048133562		
0.019100362		
0.013721307		

Ardından dengeli jeoid yüksekliğinin duyarlılığını hesapladık. Bu değer mo <= -+ 1 dm olmalıdır, aksi takdirde yüzey polinomun derecesi aşamalı olarak artırılmalıdır. Bu uygulamada mo değerimiz mo <= -+ 1 dm bağıntısını sağlamaktadır. Daha sonra mx (mai) değerinin hesabını yaptık.

$$\overline{m}_o = \mp \sqrt{\frac{v^T v}{n-u}}$$

$$m_{a_i} = m_o \sqrt{Q_{xx}}$$

3-b)

Uygulamanın bu kısmında parametre anlamlılık testi uygulayarak anlamlı parametrelerin tespitini yaptık. Daha sonra a_o anlamlı parametresini düzeltme işlemleri için tekrardan uygulamasını yaptık.

Sonuç olarak en uygun polinom derecemiz (n) 3, anlamlı katsayımızın a_o olduğu tespiti yapıldı.

T = |X| / m_x	sınır değer	Karar	NN
755.0882749	2.446911851	ANLAMLI	a_0
0.931586058	2.446911851	ANLAMSIZ	a_1
0.89353183	2.446911851	ANLAMSIZ	a_2
1.835849094	2.446911851	ANLAMSIZ	a_3
1.745612874	2.446911851	ANLAMSIZ	a_4
0.476690331	2.446911851	ANLAMSIZ	a_5
0.312107991	2.446911851	ANLAMSIZ	a_6
0.092154126	2.446911851	ANLAMSIZ	a_7
0.06635165	2.446911851	ANLAMSIZ	a_8
0.150608755	2.446911851	ANLAMSIZ	a_9

a_0
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000

QXX	AT*L	X	V =AX-L
0.0625	575.59	35.974375	-0.066725
			-0.221225
			0.332375
			0.000975
			0.114475
			0.026775
			-0.086125
			-0.028125
			-0.082725
			-0.233225
			-0.240625
			0.054375
			0.141175
			0.202375
			0.150475
			-0.064225

f	15
n	16
u	1
m_0	0.162407867
m_x	0.040601967

düzeltilmiş			
T = |X| / m_x	sınır değer	Karar	NN
886.0254276	2.131449546	ANLAMLI	a_0

3-c)

Uygulamanın bu kısmında IZDOGAP ağından 5 yeni noktanın küçük h ve H değerini EK-1'den çektik. Polinomumuzun N = a_o olduğu tespit edilerek, düzeltilmiş ortometrik yükseklik değerinin hesabını yaptık.

		N = (a_0)	36.00963334	
nokta adı	h (m)	H(m)	Düzeltilmiş Ortometrik Yükseklik (h-N)	FARK
1	155.9092	119.5752	119.8995667	0.324366656
2	213.8734	178.4003	177.8637667	-0.536533344
3	189.2755	153.9951	153.2658667	-0.729233344
4	79.2462	43.861	43.23656666	-0.624433344
5	136.2698	100.7859	100.2601667	-0.525733344

En son gerçek değerler ile yapmış olduğumuz fark hesabı sonucun farkların desimetre hassasiyetinde olduğunu gözlemledik. Gerçek değerler ile benzer sonuçlar çıktığı gözlemlenmiştir.

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