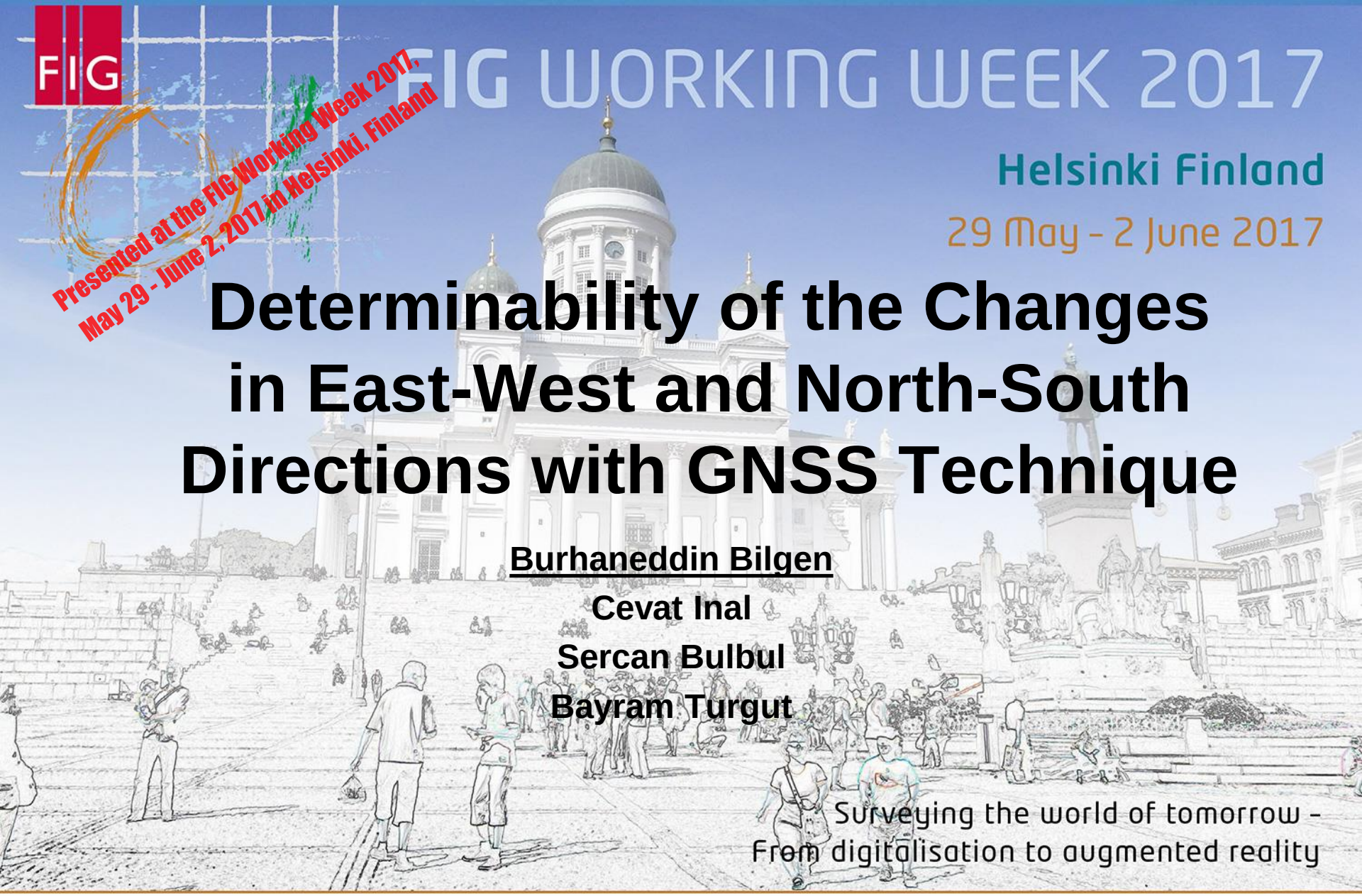


Determinability of the Changes in East-West and North-South Directions with GNSS Technique

Burhaneddin Bilgen
Cevat Inal
Sercan Bulbul
Bayram Turgut

INTRODUCTION

- Nowadays, GPS (**G**lobal **P**ositioning **S**ystem), GLONASS (**GLO**bal'naya **NA**vigatsionnaya **S**putnikovaya **S**istema (Global Navigation Satellite System)), GALILEO, BEIDOU and other independent positioning systems, which are developed by different countries, become indispensable tools to determine point positions.

- Compared to classical techniques, GNSS techniques improve measurement accuracy, productivity and monitoring capacity

- Relative positioning methods are commonly used in geodetic applications. Geodetic networks, which have high accuracy can be established by using these methods.

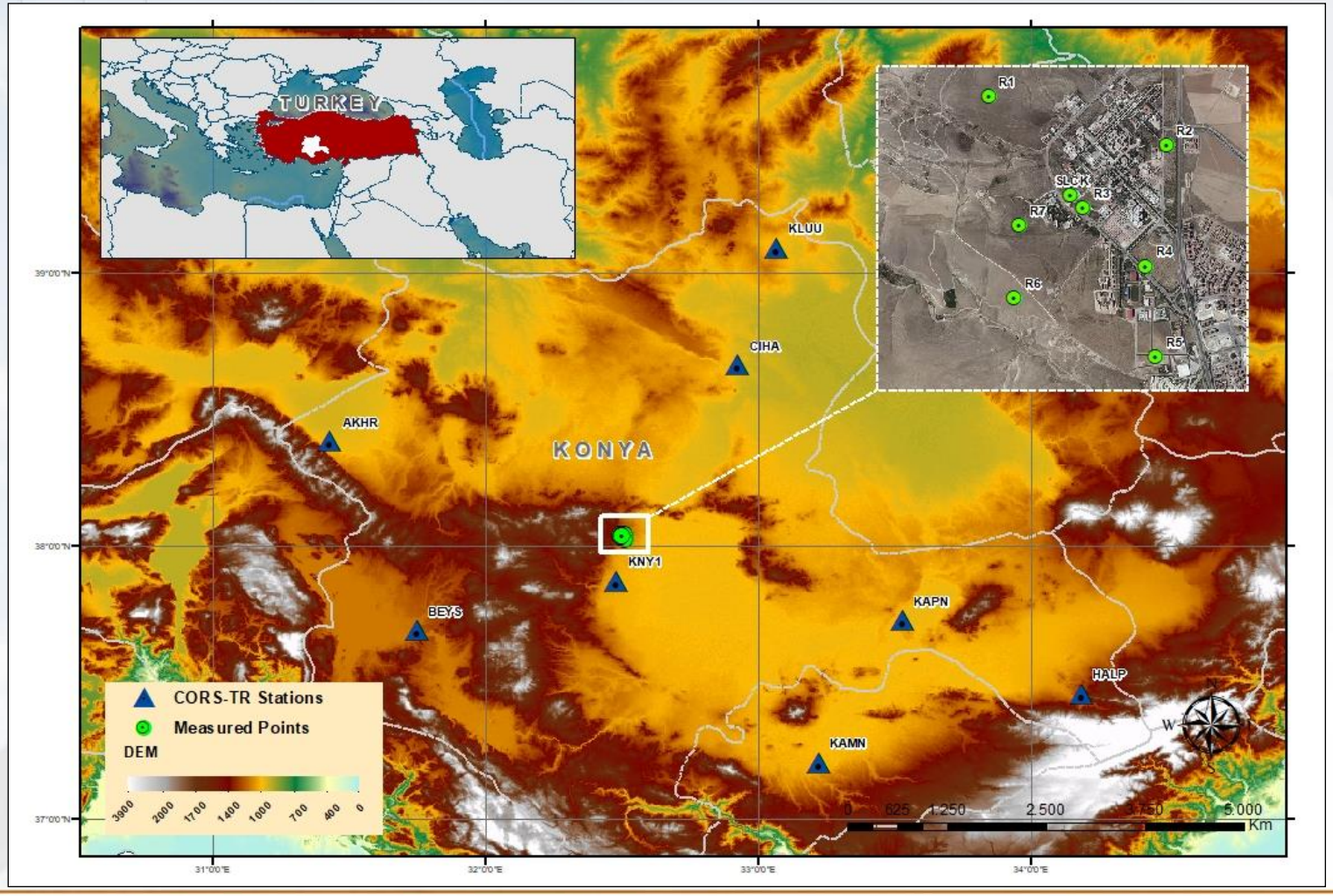
STATIC RELATIVE POSITIONING

- The GNSS technique has been a widely used method since the end of the 1980s.
- While point coordinates can be determined by using post process with GNSS technique at the beginning, in recent times these coordinates can be also determined in real time.
- With post process, the point coordinates can be determined by different methods. These methods are static positioning, rapid static positioning and pseudokinematic positioning.
- In applications requiring high accuracy, such as deformation measurements, tectonic plate movements, monitoring of large engineering constructions, the static positioning method is preferred because of the high accuracy.

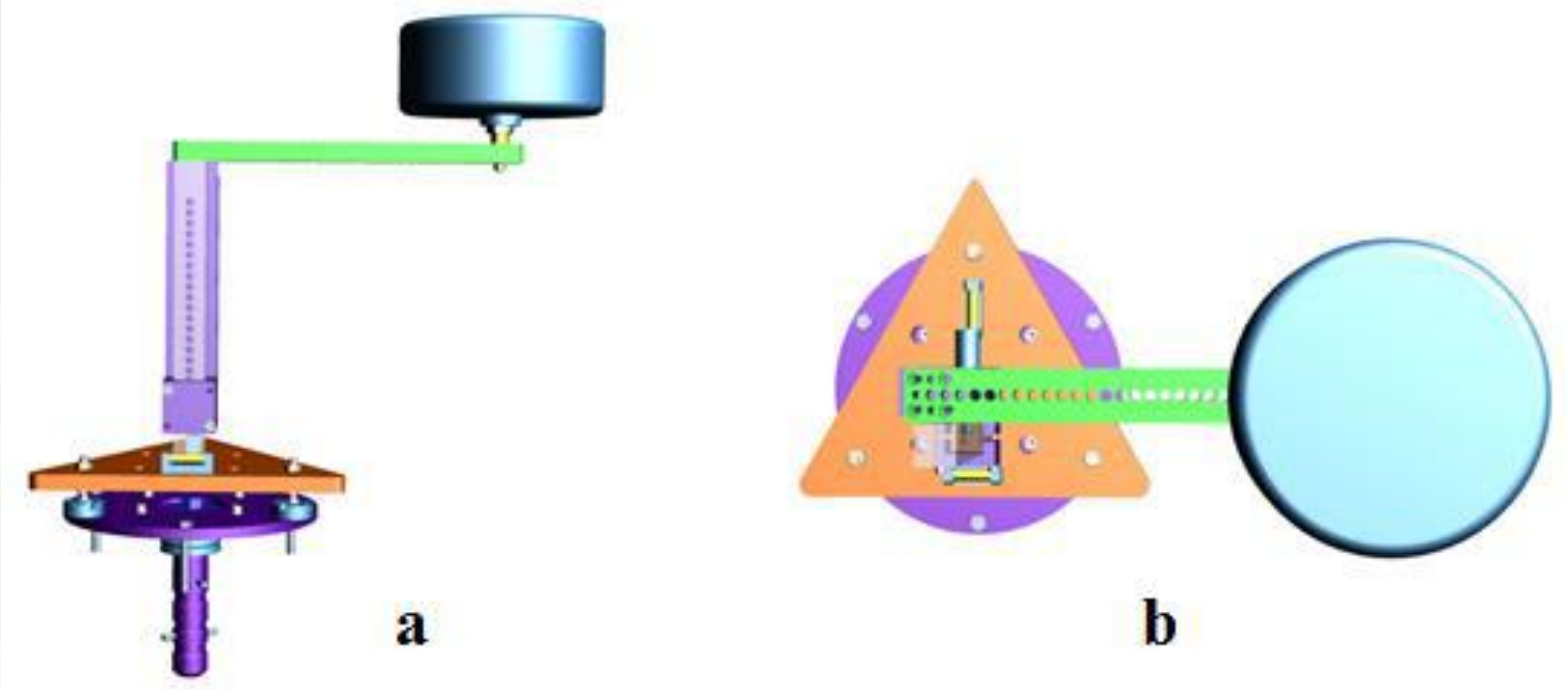
- Accuracies for relative positioning

Mode	Horizontal accuracy
Static	5 mm + 0.5 ppm
Kinematic	5 cm + 5 ppm

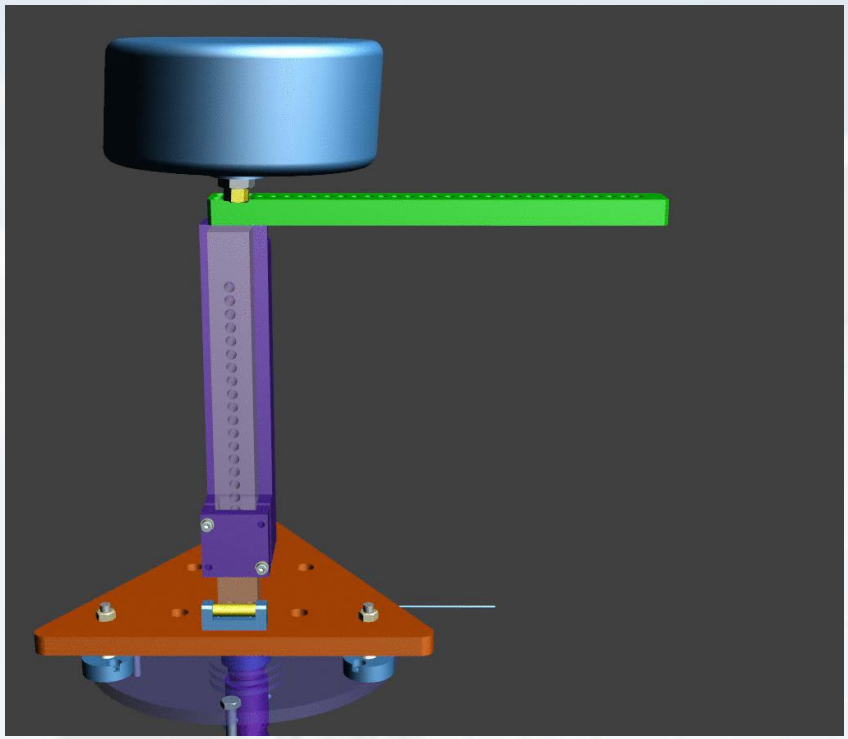
STUDY AREA


TURKEY
KONYA
KLUU
CIHA
AKHR
KNY1
BEYS
KAPN
HALP
KAMN
R1
R2
SLCK
R3
R7
R4
R6
R5
CORS-TR Stations
Measured Points
DEM
3800
2000
1700
1400
1000
700
400
0
0
625
1.250
2.500
3.750
5.000
Km
39°00'N
38°00'N
37°00'N
31°00'E
32°00'E
33°00'E
34°00'E

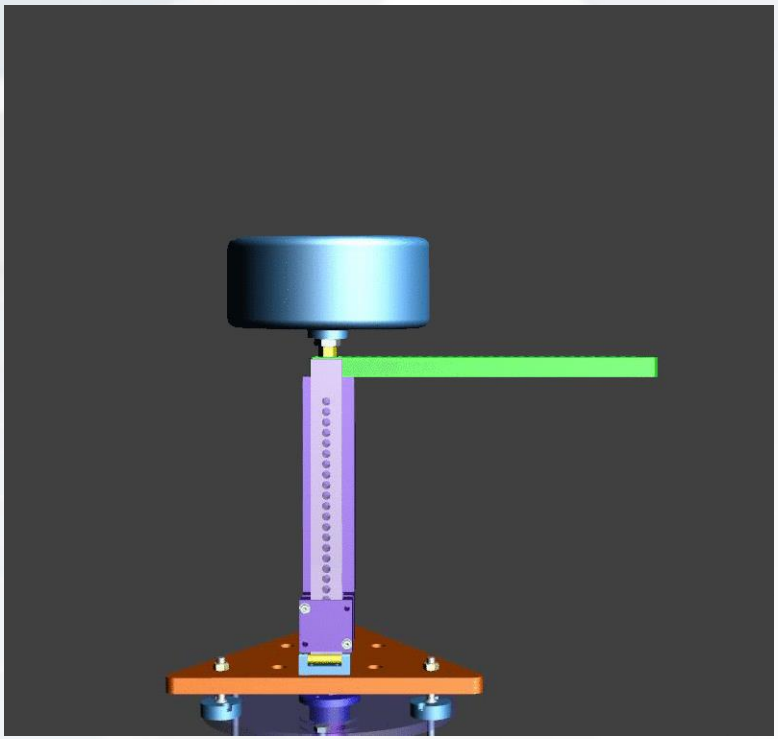
INTRODUCTION OF MECHANISM



- The view of mechanism from side (a) and top (b)



a



b

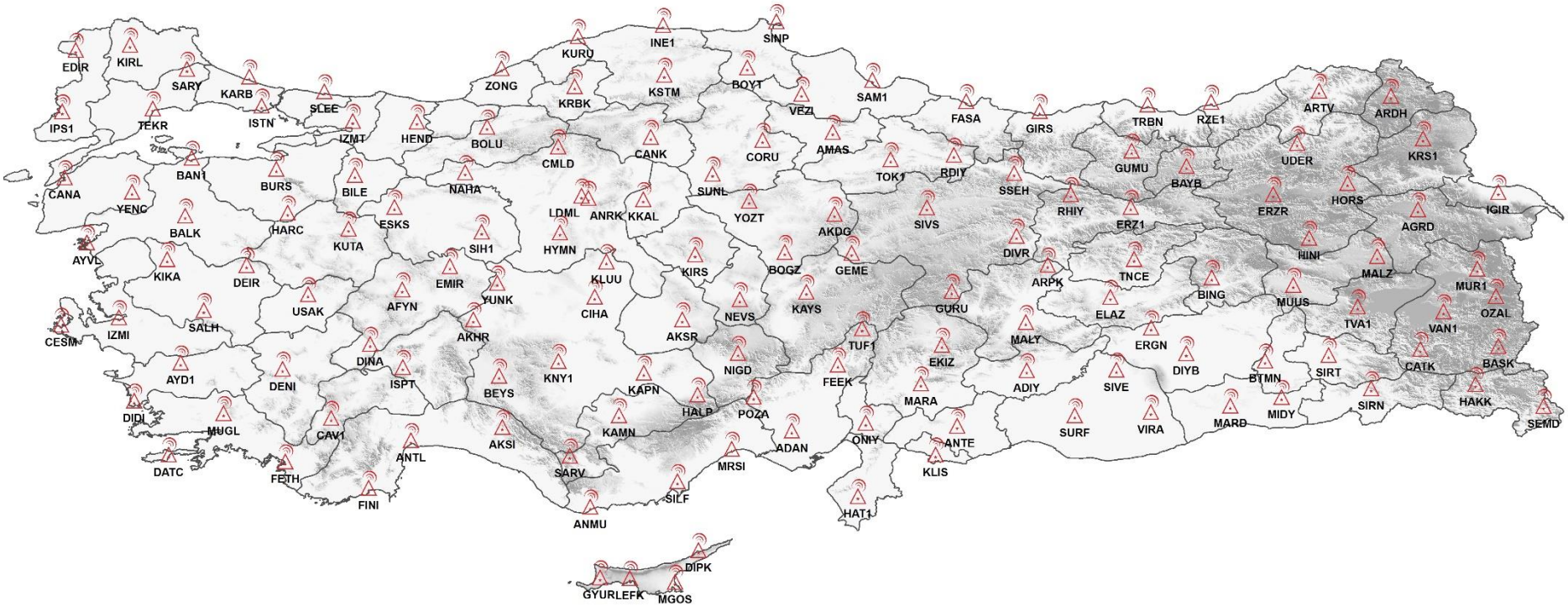
a

b

MEASUREMENTS AND EVALUATION


R1
R2
SLCK
R3
R7
R6
R4
R5


KLUU
YUN1
CIHA
AKHR
SLCK
KNY1
BEYS
KAPN
HALP
KAMN


EDIR
KIRL
SARY
KARB
IPS1
TEKR
ISTN
SLEE
IZMT
HEND
ZONG
KURU
INE1
SINP
BOLU
KRBK
KSTM
BOYT
VEZI
SAM1
FASA
GIRS
TRBN
RZE1
ARTV
ARDH
CANA
BAN1
BURS
BILE
NAHA
CMLD
CANK
CORU
AMAS
TOK1
RDIY
SSEH
GUMU
BAYB
UDER
KRS1
YENC
BALK
HARC
ESKS
KUTA
LDML
ANRK
KKAL
SUNL
YOZT
AKDG
SIVS
RHIY
ERZ1
ERZR
HORS
IGIR
AGRD
AYVL
KIKA
DEIR
SIH1
HYMN
KLUU
KIRS
BOGZ
GEME
DIVR
HINI
MALZ
MUR1
EMIR
YUNK
ARPK
TNCE
BING
MUUS
OZAL
CESM
IZMI
SALH
USAK
AFYN
CIHA
NEVS
KAYS
GURU
ELAZ
TVA1
VAN1
AKHR
AKSR
TUF1
MALY
ERGN
DINA
NIGD
EKIZ
DIYB
CATK
BASK
AYD1
DENI
ISPT
BEYS
KNY1
KAPN
FEEK
ADIY
SIVE
BTMN
SIRT
MARA
HALP
POZA
MARD
MIDY
SIRN
HAKK
DIDI
MUGL
CAVI
AKSI
KAMN
ADAN
ONIY
ANTE
SURF
VIRA
SEMD
DATC
ANTL
MRSI
KLIS
FETH
SARV
FINI
SILF
HAT1
ANMU
DIPK
GYURLEFK
MGOS

Evaluation in the North direction

Points	dx (mm)	dy (mm)	m_{dx} (mm)	m_{dy} (mm)
0 - 1	12.2	-0.2	±3.8	±2.9
1 - 2	9.1	0.4	±3.5	±2.9
2 - 3	9.8	0.2	±3.1	±2.7
3 - 4	11.7	-1.1	±3.1	±2.8
4 - 5	11.0	0.1	±3.7	±3.2
5 - 6	11.4	0.5	±3.8	±3.2
6 - 7	7.2	-0.4	±3.2	±2.7
7 - 8	8.7	-2.0	±3.3	±2.8
8 - 9	11.0	0.6	±3.5	±3.0
9 - 10	9.9	-0.9	±3.0	±2.8

Evaluation in the East direction

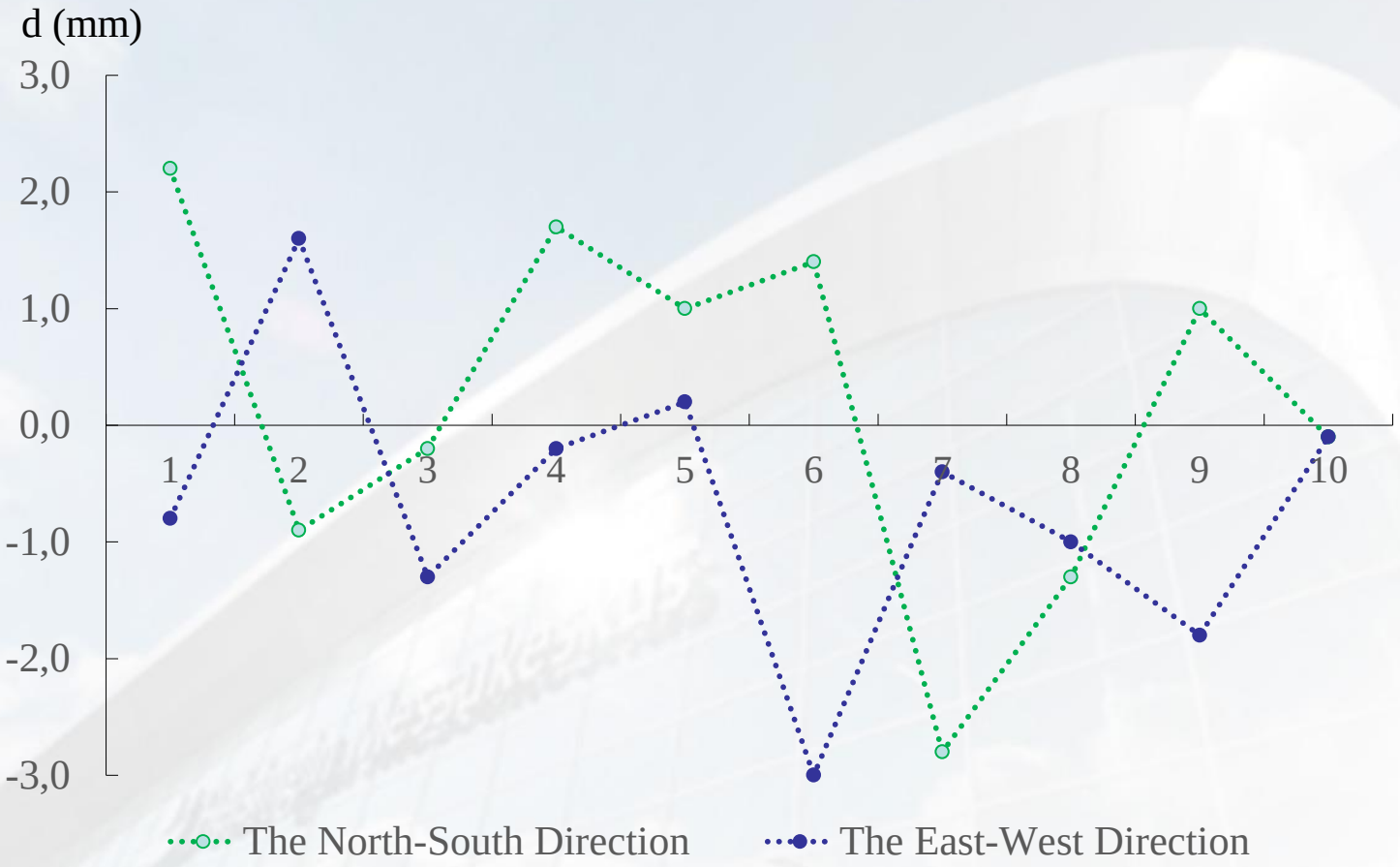
Points	dx (mm)	dy (mm)	m_{dx} (mm)	m_{dy} (mm)
0 - 1	0.7	9.2	±2.1	±1.8
1 - 2	0.0	11.6	±2.1	±1.8
2 - 3	0.0	8.7	±2.1	±2.0
3 - 4	-1.1	9.8	±2.1	±1.9
4 - 5	1.2	10.2	±2.2	±1.8
5 - 6	2.9	7.0	±2.1	±1.9
6 - 7	3.4	9.6	±2.1	±1.8
7 - 8	-0.2	9.0	±1.9	±1.8
8 - 9	0.3	8.2	±1.9	±1.8
9 - 10	0.8	9.9	±1.8	±1.6

North direction

d (mm)	m_{dx} (mm)	Test Value t	Result T_{table}=1.96
2.2	±3.8	0.58	$t<T_{table}$ Differences are not significant.
-0.9	±3.5	0.25	
-0.2	±3.1	0.06	
1.7	±3.1	0.55	
1.0	±3.7	0.27	
1.4	±3.8	0.37	
-2.8	±3.2	0.88	
-1.3	±3.3	0.39	
1.0	±3.5	0.29	
-0.1	±3.0	0.03	

East direction

d (mm)	m_{dy} (mm)	Test Value t	Result T_{table}=1.96
-0.8	±1.8	0.43	$t<T_{table}$ Differences are not significant.
1.6	±1.8	0.90	
-1.3	±2.0	0.65	
-0.2	±1.9	0.10	
0.2	±1.8	0.11	
-3.0	±1.9	1.57	
-0.4	±1.8	0.22	
-1.0	±1.8	0.57	
-1.8	±1.8	1.02	
-0.1	±1.6	0.06	


d (mm)
3,0
2,0
1,0
0,0
-1,0
-2,0
-3,0
1
2
3
4
5
6
7
8
9
10
The North-South Direction
The East-West Direction

CONCLUSION

- GNSS techniques, as well as classical terrestrial techniques, can be widely used today in determining point positions. The use of GNSS techniques is easier, faster and more economical than terrestrial techniques.
- With the help of the mechanism designed in this study, the point positions were virtually changed in the direction of the coordinate axes and the determinability of these changes was investigated. Coordinates of consecutive points were determined by the static relative positioning on the mechanism and the calculated position changes were compared with real value on the mechanism.

- If it is assumed that the statistical value is 1.96, it can be seen that coordinate changes higher than 5.8 mm in the north-south direction and 3.1 mm in the east-west direction can be determined with this system. It is considered that d values and rms may vary depending on the number of reference points used, the distance of the object point to the reference points, and session durations.

THANK YOU