



Using Virtual Reference Stations “VRS” in Positioning

A Thesis

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Ain Shams University for the Fulfillment
Of the Requirements of M. Sc. Degree
In Civil Engineering - Surveying

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Statement

This Thesis is submitted to Ain Shams University, Faculty of Engineering for the degree of M. Sc. in Civil Engineering.

The work included in this thesis was carried out by the author from 2010 to 2016 and no part of the thesis has been submitted for a degree or a qualification at any other University or Institution.

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

To reach centimeters or millimeters levels accuracy of positioning, this requires using of precise dual-frequency carrier phase observations. Furthermore, these observations are usually processed using (DGPS) technique, such as real time kinematic (RTK) or post-processing (PP) where both methods have many variations based on the same concept.

The virtual reference station (VRS) technique helps satisfying this requirement using a network of reference stations connected to each other or to a control center. In contrast, GNSS network of many reference stations often make use of multiple reference stations as the reference station transmitting the corrections.

Hence, the main objective of the current research is to study the multi-reference station approach in general, especially the VRS approach versus the classical survey, showing how this new approach can help effectively in survey work.

A lot of data were used from the Egyptian CORS network for post processing, stations locations, stations setup, correcting the internal and external loops in the network and connecting the network with the IGS 2008; On the other hand, a real time data were used in Dubai by the (DVRS) network to examine the network accuracy and reliability.

A field test was done on both networks in (PP) and (RTK) modes, showing the 2D and 3D accuracies are up to mm in the Egyptian CORS with (PP) technique while the accuracy for DVRS is from 10 to 12mm in 2D coordinates and from 18 to 22mm in 3D coordinates.

Another test was done on the Egyptian VRS to show the influence of observation time on the coordinates accuracy, the results showed that after 15minutes the accuracy is acceptable – less than 10mm for (PP) and after 30 minutes its stable at almost 8 to 10mm for baselines up to 35km.

For showing the differences in using single base station and multi-reference station network from accuracy side, a field test was done in Dubai on the (DVRS), using sets of points measured by both single base and the network, it showed that the accuracy is almost the same. On the other hand, the (VRS) has better performance concerning the resulted standard deviation of the obtained coordinates.

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Table of Contents

Statement	I
Abstract	II
Acknowledgement.....	IV
List of Abbreviations.....	XII
List of Figures	XVII
List of Tables.....	XX
Chapter 1: Introduction	1
1.1 Limitations of Classical Survey versus Using CORS and VRS ..	3
1.2 The Need of Using Multi Reference Station Network and VRS ..	4
1.3 Virtual Reference Station Definition	5
1.4 CORS Networks for Kinematic Applications.....	6
1.5 The Master-Auxiliary Concept (MAC)	7
1.6 Strengths and Weaknesses of VRS versus FKP	7
1.7 GPS Surveying.....	9

1.8	Research Objectives.....	11
1.9	Thesis Outline	12
Chapter 2:	The VRS Concept	14
2.1	VRS Procedure.....	14
2.2	Control Server's Software.....	17
2.3	VRS Error Interpolation.....	18
2.4	Setting up the Server's Software.....	19
2.5	Typical Set-up for the VRS Hardware.....	19
2.6	Steps of Using VRS Network in Field Work.....	21
2.7	Operating Reference Station Networks	22
2.8	Tropospheric and Ionospheric Error Modeling in VRS.....	23
2.8.1	Tropospheric Modeling in VRS	24
2.8.1.1	Impact of the Used Tropospheric Model on the Solution in VRS Approach.....	24
2.8.1.2	The Impact of the Tropospheric Differences in VRS Approach....	26
2.8.2	Residual Errors as Result to Differences of the Tropospheric Model in VRS Approach.....	28

2.9	The Ionospheric Error Modeling	30
2.9.1	Modelling the Residual Errors of Ionospheric influence in the VRS.....	30
Chapter 3: The Egyptian Virtual Reference Station Network		31
3.1	Objectives of the Egyptian VRS Network.....	33
3.2	Network Coverage	33
3.3	Stations Locations Selection	34
3.4	Final Design for the Egyptian VRS Network	35
3.5	Reference Station Installation	39
3.5.1	Reference Station Block Diagram	39
3.5.2	Reference Station Design Criteria	40
3.5.3	Environmental Specification of the Stations	40
3.5.4	Reference Station Receiver	41
3.5.5	Sarian DR 6410 High Speed Router	42
3.5.6	External Cabinet Components.....	42
3.5.7	Antenna Mast	44
3.6	Control Center Components	44
3.6.1	Router and Backup Router	44

3.6.2	Server and Backup Server.....	45
3.6.3	Communication Options.....	45
3.6.4	Control Center Software	48
3.6.4.1	Network RTK Software.....	48
3.6.4.2	GPStream Software	51
3.6.5	Connection Router	52
3.6.6	Splitter	52
3.6.7	Rover Integrity Information Pane.....	52
3.6.7.1	Rover Integrity – Connections.....	53
3.6.7.2	Rover Integrity – NMEA.....	53
3.6.7.3	Rover Integrity – Reference Positions.....	53
3.6.7.4	Rover Integrity – Position Statistics	53
3.6.7.5	Rover Integrity – Position Errors	54
3.6.7.6	Rover Integrity – DOP	55
3.6.7.7	Rover Integrity – Number of Satellites	55
3.6.7.8	Rover Integrity – Statistics of Initialization Time.....	56
3.6.7.9	Rover Integrity – Initialization Time.....	57
3.6.7.10	Compact RINEX	57

3.6.7.11	Receiver Module Software - RTKNet.....	57
3.6.8	Control Center Servers	57
3.7	Survey Methodology.....	58
3.8	Calculations Procedure for the network Permanent Stations Coordinates	59
3.8.1	External Geodetic Connection Post Processing	60
3.8.2	Internal Geodetic Connection Post Processing.....	60
3.9	Network Adjustment and Results Summary of Data Processing Statistics.....	61
3.9.1	External Network ITRF 2008 Connection Results	61
3.9.2	Internal Network Adjustment Results.....	63
3.10	Coordinate System Transformation in Egypt.....	67
3.10.1	Checking the Differences between HARN and IGS.....	67
3.10.2	Transformation between HARN and IGS Reference Frames.....	67
 Chapter 4: Observation Duration Influence on the Network		
Accuracy of the Egyptian VRS in Post Processing Mode		74
4.1	Observation Duration Influence Test Results in PP Mode	74
4.1.1	Results and Discussion.....	78

Chapter 5: Dubai Virtual Reference Stations Network.....	83
5.1 Introduction.....	83
5.2 The Reasons of Establishing the DVRS	84
5.3 Survey Methodology and Network Design.....	85
5.4 Network Setup including HW and SW configurations.....	86
5.4.1 Stations Components	87
5.4.2 Control Center Components	87
5.4.3 Network Processing Software	88
5.5 Testing the DVRS	89
5.6 RTK Using Single Base Station versus RTK Using VRS Network	92
5.7 RTK Using Service Satellites and Future Approaches	93
Chapter 6: Summary, Conclusions and Recommendations.....	95
6.1 Summary	95
6.2 Conclusions.....	96
6.3 Recommendations.....	97

List of Abbreviations

AC – Alternating Current

ADSL – Asymmetric Digital Subscriber Line

CMR - Compact Measurement Record

CORS - Continuously Operating Reference Station

D/A - Digital to Analog

DGNS - Doppler GPS Navigation System

DGNSS - Differential Global Navigation Satellite System

DGPS - Differential Global Positioning System

DVRS - Dubai Virtual Reference Station

E - East

EGNOS - European Geostationary Navigation Overlay Service

ESA – Egyptian Survey Authority

EUREF – European Reference Frame

EVRS – Egyptian Virtual Reference Station Network

FKP – Flächen Korrektur Parameter (in Germany) = network area
corrections

GDOP - Geometric Dilution of Precision