Continuously Operating Reference Stations (CORS) Network for Pakistan: Development and its Applications

Presented by:
Syed Zahid Jamal
Divisional Head (GNSS)
SUPARCO
Outline

• Introduction
• Gap Analysis
• Establishment of Karachi CORS Network
• Applications of CORS Network
• Conclusion
Introduction

- Spatial design
- Planning and development
- Efficient usage of resources
- Transparency

Geographic Data is Vital for all organized societies

- Base for geographic data applications
- Otherwise poor integration
- Problem of inconsistency

Determination of Accurate and Precise Positioning is a must

- Standalone positioning accuracy is 5 m
- External environment adds unwanted errors
- Real Time Kinematic (RTK) – cm positioning

In Pakistan technology is in vogue

- No central facility
- High implementation cost
- Unable to meet the long term geographic data demand

GNSS provides precise positioning

- Determination of accurate and precise positioning is a must
Real Time Kinematic (RTK)

• Establish Reference station
  – At fixed known location
  – To compute correction parameters
  – To get cm-level positioning of rover

• Limitations
  – Distance increase, accuracy decrease
  – Large number of reference stations for covering large area
CORS Network

Reference Station

Satellite Data Sent to Central Server

RTCA or CNS Data Sent to Moving User

Virtual Reference Station Position

Rover User

Reference Station

Satellite Data Sent to Central Server

NMEA String Sent to Central Server

Satellite Data Sent to Central Server

Reference Station
CORS Network

• Advantages
  – The distance dependant errors are greatly reduced
  – Multi-purpose infrastructure
  – Absolute accuracy and no-single point error
  – Robust, Accurate, Reliable and Economical positioning
  – Covering larger area with few reference stations (70 km apart)
  – User needs only one RTK enabled GNSS receiver
  – Improved efficiency and transparency
A large number of public and private sectors are using single base station RTK.

Time to set up reference station is high whereas the coverage is less (5 ~ 10 km).

Un-coordinated and ad-hoc approach thus cannot meet the long term demand.

For meeting the long term demand and interoperable & homogeneous data collection of various geo-spatial applications, CORS Network is established across nationwide.
Establishment of Karachi CORS Network

- Five (05x) CORS has been
- One (01x) Master Control Center
- GPS + GLONASS + BeiDou
- Capable of providing cm-level positioning service
- WGS-84
- Real-time
- Covering Karachi and outskirts
Karachi CORS Network Services

• Services Available:
  – Real-time RTK service (Accuracy 2 to 4 centimeter)
  – Post-processing service (Accuracy 2 to 4 millimeter)
  – Training courses for end users, state officials and international GNSS related applications’ students
Accuracy Test

1. 24 hours data collected
   Determine precise positioning using PPP technique (1 cm precision)

2. 24 hours data collected
   Determine position using CORS Network (2 cm precision)
   GPS + GLONASS + BeiDou corrections

3. Compared result with processed PPP location
## Accuracy Test

<table>
<thead>
<tr>
<th>Signals</th>
<th>Duration of Test</th>
<th>Horizontal Accuracy (1σ)</th>
<th>Vertical Accuracy (1σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BeiDou+GPS+GLONASS</td>
<td>24 hours</td>
<td>1.73 cm</td>
<td>3.17 cm</td>
</tr>
</tbody>
</table>

This result shows that the accuracy observed using real time RTK technique is within limits.
Applications of CORS Network

Spatial and Surveying Industry

Land Use and Management

Mining & Quarrying

Precision Agriculture

Construction and Civil Works
Applications of CORS Network

• Spatial and Surveying Industry
  – CORS Network has great imprints on Surveying & Mapping
  – Improves work performance, reduces inconsistencies and provide efficient utilization of resources
  – As it provides fast, homogenized and economical means of positioning data
  – Thus, provides a platform for accurately mapping each and every infrastructure with standardized positioning
Applications of CORS Network

• Land Use and Management
  – Land property usually consists half to three quarter of national wealth in any economy
  – Therefore, government builds and maintains land administration system for efficient and effective land market
  – CORS Network facilitates in developing an efficient and transparent land information system for rights and recognition of property, taxation, planning and management through e-government environment
Applications of CORS Network

• Mining & Quarrying
  – Extraction of minerals and ores through efficient and economical means provide a competitive edge for the development of developing countries
  – CORS Network has tremendously transformed the mining and quarrying process by automatic steering and on-board graphics console for operations
Applications of CORS Network

• Precision Agriculture
  – Robotic tractors with automatic machine guidance are used for precision agriculture
  – This machine guidance requires precise positional accuracy of 2.5 cm or less for ploughing, seeding, harvesting and precise water and fertilizer placement for any size and terrain of farm
  – CORS Network provides homogenous positional accuracy for such operations
Applications of CORS Network

- Construction and Civil Works
  - RTK technique provides statistically compatible results against traditional means of surveying utilizing the total stations etc
  - CORS Network provides efficient means of surveying at construction sites where frequent surveying is required by reducing the resources
Conclusion

• SUPARCO has successfully established CORS Network for demonstration of technology

• Capable of providing real-time precise positioning services in WGS-84

• This network will enhance the geo-spatial applications with high-tech product and convenience
Thank You

Syed Zahid Jamal
Divisional Head (GNSS)
Pakistan Space & Upper Atmosphere Research Commission (SUPARCO)
manager.gnss@suparoc.gov.pk