Civilian and Scientific applications - using GAGAN/NavIC

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Civilian and Scientific applications - using GAGAN/NavIC

• Ground Control Points (GCPS) – Data Collection
• ISRO-GAGAN Hyperlapse Imaging System
• Cadastre resurvey
• Inventory & Site Monitoring plans for Heritage Sites and Monuments of National Importance
• Mining Boundary mapping
• Mobile app with GAGAN Bluetooth Device
• Map updation - Bridges / Flyover Models using GAGAN SBAS
Ground Control Point Library (GCPL)

Role of Ground Control Points

- Geometric calibration of satellite / platform
- Triangulation\(^1\) of Satellite/Aerial Data for the generation of DEM\(^2\) and Ortho\(^3\) data.

GCP Schema

GCPL Design

- Location analysis with varying occupation
- Observation of 30 min in static position on a point provided 50cm(1σ)
- 3 tier client server database
- More than 1500 GCPs collected

1 – Triangulation is the process of determining the location of a point by measuring angles to it from known points at either end of a fixed baseline, which will help to densify the control points.
2 – Digital Elevation Model: Grid with Geographic location and height information
3 – Ortho Data corrected for terrain and tilt angle.
GAGAN Receiver - Geotagging

- GAGAN – GPS Aided Geo Augmented Navigation
  - Integrity, Accuracy, Reliability, Availability
- Jointly developed by ISRO and Airports Authority of India for Aircraft Navigation
- Dongle Based Receiver
- Sampling Rate: 1 second
- Geotagging of Still images
- Geo-path of video track
- Accuracy better than 2m

GNSS & SBAS Sky Plot  |  Positional Accuracy  |  GAGAN SBAS – Ground Trace

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>L1 Frequency, CA code</td>
<td>Horizontal Position</td>
<td>&lt; 2 m (autonomous)</td>
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<td></td>
<td></td>
<td>&lt; 2 m (iDAS)</td>
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<tr>
<td></td>
<td>Velocity Accuracy</td>
<td>&lt; 0.1 m (speed)</td>
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<tr>
<td></td>
<td></td>
<td>&lt; 0.1 (heading)</td>
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<tr>
<td>Time To First Fix</td>
<td>Autonomous</td>
<td>&lt; 15 sec</td>
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<tr>
<td></td>
<td>Warm start</td>
<td>&lt; 30 sec</td>
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<tr>
<td></td>
<td>Cold start</td>
<td>&lt; 60 sec</td>
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<tr>
<td>Sensitivity</td>
<td>Autonomous</td>
<td>&lt; 14 dBm (acquisition)</td>
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<td></td>
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<td>&lt; 17 dBm (tracking &amp; navigation)</td>
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<tr>
<td>Max. Update Rate</td>
<td>5 Hz</td>
<td></td>
</tr>
<tr>
<td>Max. Altitude</td>
<td>&lt; 50,000 m</td>
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<tr>
<td>Max. Velocity</td>
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<td>Protocol Support</td>
<td>SBAS v2.3 (compatible to 3.0), ARAIS, and ISRO’s Sky Plot</td>
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<tr>
<td></td>
<td>GAGAN</td>
<td>WGS-84</td>
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<tr>
<td>SBAS Support</td>
<td>WAAS, EGNOS, MSAS, GAGAN</td>
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Scatter Plots: GAGAN SBAS Data
(30 minutes observation)
ISRO-GAGAN HYPERLAPSE IMAGING SYSTEM

- **ISRO GAGAN HYPERLAPSE IMAGING SYSTEM (I-GHIS)**
  - Indigenous low cost 360° image acquisition system
  - Conceptualized, designed and developed at NRSC, ISRO
  - GAGAN SBAS corrected coordinates for position information
  - Camera Rig realized through 3D printing
  - Light Weight System: 1.2 kg
  - Mountable on UAVs, SUVs/MUVs, Tripod, Backpack etc.

- **GAGAN SBAS coordinates integrated with 360° views**
  - Still images and Video
  - Generation of interactive geotagged panoramas, walk through and 360° virtual tours
  - Virtual reality solution on ISRO’s Geoportal Bhuvan
  - Catering to Civilian and Non-Aviation applications
I-GHIS Data Processing Methodology

- **Hyperlapse Data Acquisition**
- **Image /Video Data Processing**
- **Panorama Generation**
- **Geotagging of Panorama**
- **Generation of 360° virtual tours**
- **Ingestion in Bhuvan – ISRO’s Geo-portal**

**GAGAN SBAS RECEIVER for GEO TAGGING (Dongle based)**

**Data Acquisition**

**Panorama Generation**

**Geotagging**

**360° Tour**
The objective of the study is to demonstrate the usefulness of GAGAN for Cadastral mapping.

Pilot study
Shabashpalle village, Medak district, Telangana State

Area = 1600 acres

Existing:
Total polygons = 350

Gagan Cadastre:
No. of polygons = 540
Cadastral Resurvey - GAGAN

- Gagan dongle connected to laptop & attached to cap
- Land records verified in the presence of land owners and officials
- Data evaluation & Attribute data collection

Due to industrialization

Bigger parcels

Survey numbers split into sub parcels due to inheritance

Old

New
## GAGAN survey - Validation

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<th>Sy. No.</th>
<th>Total Station (acres)</th>
<th>GAGAN (acres)</th>
<th>% Diff.</th>
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<td><strong>Average</strong></td>
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Inventory & Site Monitoring plans for Heritage Sites and Monuments of National Importance

Activity I: Geodatabase Creation
- Geospatial Inventory of all notified 3658 heritage sites
- Preparation of site management plans

Database ready & available on Bhuvan

Ease of doing Business

Activity II: Location based services & Mobile apps
G2C Application: Smart Citizen App for online request processing

G2G Application: App
Empower ASI field Staff to Collect
- The Geocoordinates of Sites and Monuments
- Generate any Admin/Management Boundary around a site/Monument

Smartphone based Android application
- Dual Option GPS
  - GAGAN
  - Inbuilt GPS
Monitoring of Mining Activities

- Monitoring of Mining Activities/Changes within Mining lease area using Time Series Satellite Imagery
  - Project: Sudoor Drishti

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<td>2007-15</td>
<td>253520.6</td>
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GAGAN MINE BOUNDARY MAPPING
Monitoring of Mining Activities

- GAGAN enabled SBAS receiver was used in the updation of transportation network features.

- Eg. bridges, flyovers etc., into existing large scale spatial databases.
Mobile app with GAGAN Bluetooth Device

- Bhuvan CCLA app to geo-tag Telangana Govt. leased land parcels using Bluetooth GAGAN receivers.
- Bhuvan Waqf app to map the properties of Waqf board using USB GAGAN receivers.
- g-Girdavari app to map the property boundary of Agriculture lands using USB GAGAN receivers.