Review of RAW GNSS Measurements

58th Meeting of the Civil GPS Service Interface Committee

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24th September 2018
Nottingham Geospatial Institute, University of Nottingham
GSA RAW Measurements Task Force
• University of Nottingham
  • Simon Roberts
  • Oluropo Ogundipe
• GSA Task Force
  • Moises Navarro-Gallardo (Airbus)
  • Paolo Crosta (ESA)
  • Justyna Redelkiewicz-Musial (GSA)
• The Royal Norwegian Naval Academy
  • Oeystein Glomsvoll
Introduction to RAW GNSS
Google Play Services (android.gsm.location)
android.location in Android 7.0+

Android Stack

Google Maps, Google Fit, GnssLogger
Places, Nearby Activity Recognition, Geofencing, FLP,
Sensors, GNSS Raw Measurements
Abstraction to the physical Hardware
Physical Drivers

RAW GNSS Measurements are found here

GNSS, WiFi, BLE, and Sensor chips live down here
Fused location provider

GNSS Info -> FLP -> GPS

Location -> FLP

Network Location (NLP) -> FLP

Accel -> FLP

Gyro -> FLP

Mag -> FLP

Baro -> FLP
Processing data

Courtesy of Moises Navarro-Gallardo

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Hardware Limitations

- Simple linearly polarised antenna\(^1\);
- Duty cycle affects carrier phase\(^2\);
- Galileo constellation not fully implemented;
- Background application and UX issue, leading to large battery drain devices and overheating;
- Non-dedicated hardware\(^3\), poor clock, self-interference and performance differences even between same models;
- Difference with internal PVT solution.

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\(^2\) Controllable in Android P developer options.

\(^3\) Hardware 2016+ and APIv24+.
Jamming detection
Factors influencing detection

- Jammer signal characteristics and power;
- Probe hardware and front end design, antenna;
- Differences between sensors;
- Terrain characteristics;
- Proper identification of the event;
- Probes distribution and known positions’ accuracy.

Courtesy of Oluropo Ogundipe
Detection

Glomsvoll and Bonenberg, 2016

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Multipath and urban canyons

Unsplash/CC0 Courtesy of Ms Alina Wang
Positional accuracy

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<thead>
<tr>
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<th>Planar Accuracy [m]</th>
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<td>SPS</td>
</tr>
<tr>
<td>Open Area</td>
<td>2.3</td>
</tr>
<tr>
<td>Urban-like MP</td>
<td>48.5</td>
</tr>
<tr>
<td>MP corrected(^a)</td>
<td>3.1</td>
</tr>
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<td>MP corrected (GPS only)</td>
<td>15.5</td>
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\(^a\)S. Roberts et al, 2017

Table 1: Three minutes average of GPS+GLO PVT in different conditions

Courtesy of Ge Shi
### Positional accuracy

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**Table 1:** Three minutes average of GPS+GLO PVT in different conditions

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*aS. Roberts et al, 2017"
Sensors everywhere?
Communication channel effect on differential corrections in urban environment (planar accuracy)

Courtesy of Ms Alina Wang

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What we discussed...

1. Introduction to RAW GNSS
2. Jamming detection
3. Summary
Take away

- Low cost hardware is limited in comparison with geodetic grade, and especially dedicated font ends;
- New developments are very promising, especially dual frequency and AGC. Let’s start with proximity and then do distance and direction;
- Android offer an unique benefit of engaging and informing public as well as widening general community;
- Keep exchanging ideas, encouraging discussion with public.