MGA Webinar Series : 9

Updates on GNSS Raw Data Measurement from Android Device

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16th July 2019
Purpose

• Provide updates related with Android GNSS Raw Data
  • Results from Raw Data Processing
    • Tokyo, Japan
    • Suva, Fiji
    • Melbourne, Australia
    • Florida, USA
  • Sharing of Raw Data to practice
• Please refer MGA Webinar #8 for additional information
  • https://home.csis.u-tokyo.ac.jp/~dinesh/WEBINAR.htm
Android Device for GNSS Raw Data

• Many Android devices with OS 7.0 or higher can output GNSS Raw Data
  • These data can be used for RTK post-processing
• Some devices have Multi-Frequency (L1/L5) GNSS receiver
  • Multi-System (GPS, GLONASS, GALILEO, BEIDOU, QZSS)
  • Multi-Frequency (L1/E1/B1, L5/E5)
  • Outputs more than 40 channels
  • Some devices output NAV BIT Data and/or AGC values

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## GNSS Raw Data Compatible Smart-Phones

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Check ➔ [https://developer.android.com/guide/topics/sensors/gnss](https://developer.android.com/guide/topics/sensors/gnss) for Latest Updates
Android Raw Data Logging Tool – 1: GnssLogger
GNSS Raw Data Output Format from Smart Phone Device

• #
• # Header Description:
• # Version: v2.0.0.1 Platform: 9 Manufacturer: Xiaomi Model: MI 8
• # Raw,
  • ElapsedRealtimeMillis,TimeNanos,LeapSecond,TimeUncertaintyNanos,FullBiasNanos,
  • BiasNanos,BiasUncertaintyNanos,DriftNanosPerSecond,DriftUncertaintyNanosPerSecond,
  • HardwareClockDiscontinuityCount,Svid,TimeOffsetNanos,State,ReceivedSvTimeNanos,
  • ReceivedSvTimeUncertaintyNanos,Cn0DbHz,PseudorangeRateMetersPerSecond,
  • PseudorangeRateUncertaintyMetersPerSecond,AccumulatedDeltaRangeState,
  • AccumulatedDeltaRangeMeters,AccumulatedDeltaRangeUncertaintyMeters,CarrierFrequencyHz,
  • CarrierCycles,CarrierPhase,CarrierPhase Uncertainty,MultipathIndicator,
  • SnrInDb,ConstellationType,AgcDb,CarrierFrequencyHz
• # Fix,
  • Provider,Latitude,Longitude,Altitude,Speed,Accuracy,(UTC)TimeInMs
• # Nav,
  • Svid,Type,Status,MessageId,Sub-messageId,Data(Bytes)
Sample GNSS Raw Data Output
GNSS Raw Data Analysis Tool for GnssLogger

• GNSS Analysis APP
  • Matlab-based Tool
  • Linux, Windows, MacOS
  • Version 2.6.3.0
  • Release Notes: https://developer.android.com/guide/topics/sensors/gnss#releaseGNSS Analysis app v2.6.3.0 release notes.

The GNSS Analysis app is built on MATLAB, but you don’t need to have MATLAB to run it. The app is compiled into an executable that installs a copy of the MATLAB Runtime.
Position Output from Android GNSS Receiver, Komaba

- Standard Position Computation
  - No DGPS or RTK Corrections
  - All visible GNSS Satellites are used
  - Frequency: L1/L5/E5
  - Surrounding: Tall Buildings around
Position Output from Android GNSS Receiver, Hongo

Smart-Phone is kept under the Tree
Red Circle Radius : 5m
Position Output from Android GNSS Receiver

Smart-Phone is kept in an Open Area
Red Circle Radius: 5m
Smart-Phone is kept on a Bench in the park
Red Circle Radius: 5m
SEE Next SLIDE
Smart-Phone is kept on a Bench in the park
Red Circle Radius: 5m
Output from GNSS Analysis Tool, Data Logged by GNSSLogger

Data logged by Mi8 Smart-phone inside the car

Contact: dinesh@iis.u-Tokyo.ac.jp
Output from GNSS Analysis Tool, Data Logged by GNSSLoger

Location: Kennedy Space Center, Florida

Data logged by Mi8 Smart-phone inside the car Driving from Hotel to Kennedy Space Center
Output from GNSS Analysis Tool, Data Logged by GNSSLogger

Data logged by Mi8 Smart-phone inside the car
Driving from Hotel to Kennedy Space Center

Contact: dinesh@iis.u-Tokyo.ac.jp
GNSS Position Data from Mi8 Android Device

Yellow Circles : Mi8 Device
White Circle    : 5m Radius

Location: SUVA, FIJI
GNSS Position Data from P20 Android Device

Red Circles : P20 Device
White Circle : 5m Radius

Location: SUVA, FIJI
GNSS Position Data from Mi8 & P20 Android Devices

Red Circles : P20 Device
Yellow Circles : Mi8 Device
White Circle : 5m Radius

Location: SUVA, FIJI
Position Output from Android GNSS Receiver
海洋大学 (TUMSAT)

- Mobile-phone is kept static for about 60 min then moved around the roof.
- A GNSS base-station (Trimble NetR9) on the roof is used to collect correction data.

These data were logged at TUMST, Dr. Yize
**Android GNSS Raw Data Information**

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GPS L1 vs GPS L1/L5

Data logged by Mi8 Smart-phone
GPS L1 vs GPS + QZS L1

Data logged by Mi8 Smart-phone
GPS L1 vs GPS + QZS L1/L5

Data logged by Mi8 Smart-phone
GPS L1 vs GPS + QZS + BDS L1

Data logged by Mi8 Smart-phone
GPS L1 vs GPS + BDS + QZS L1/L5

Data logged by Mi8 Smart-phone
GPS L1 vs GPS + GAL+ BDS + QZS L1

Data logged by Mi8 Smart-phone
GPS L1 vs GPS + GAL+ BDS + QZS L1/L2/L5
GPS L1 vs GPS + GLO + GAL + BDS + QZS L1

Data logged by Mi8 Smart-phone
GPS L1 vs GPS + GAL+ BDS + QZS L1/L5

Data logged by Mi8 Smart-phone

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(Possible) Applications of Android GNSS Raw Data

• High-Accuracy Positioning
  • Multi-System, Multi-Frequency

• Interference and Jamming Detection
  • Crowd Sourcing

• Spoofing Detection

• Signal Authentication

• Atmospheric Parameter Estimations
  • Ionosphere and Troposphere

• Space Weather

• Scientific Applications
White Paper on GNSS Raw Data Measurement

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GNSS Raw Measurements Taskforce Workshop

GNSS Raw Measurements Taskforce Workshop was held on 26th June 2019, Prague, GSA European Agency Headquarters

Refer https://www.gsa.europa.eu/gnss-raw-measurements-taskforce-workshop for more information
References

• GNSS Raw Data Measurement Tutorial File by Dr, Frank Van Diggelen, Google Inc.
  • [https://home.csis.u-tokyo.ac.jp/~dinesh/GNSS_Raw_files/GNSS%20102%20Measurements%20from%20Phones%20Short%20Course%20Slides.pdf](https://home.csis.u-tokyo.ac.jp/~dinesh/GNSS_Raw_files/GNSS%20102%20Measurements%20from%20Phones%20Short%20Course%20Slides.pdf)

• GPS Receiver Signal Processing background information file:
  • [https://home.csis.u-tokyo.ac.jp/~dinesh/WEBINAR_files/MGA_W08_RawDataMeasurement_Background.pdf](https://home.csis.u-tokyo.ac.jp/~dinesh/WEBINAR_files/MGA_W08_RawDataMeasurement_Background.pdf)

• Video record of GNSS Raw Signal Measurement MGA WEBINAR held on 6th DEC 2018.
  • [https://www.youtube.com/watch?v=S217xg--O_Q&feature=youtu.be](https://www.youtube.com/watch?v=S217xg--O_Q&feature=youtu.be)

• Sample Data
  • Sample GNSS Raw Data from Android Device
    • [https://home.csis.u-tokyo.ac.jp/~dinesh/WEBINAR.htm](https://home.csis.u-tokyo.ac.jp/~dinesh/WEBINAR.htm)