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REAL TIME ANALYSIS OF MOBILE GPS DATA

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Abstract

In this new era of technological advancements, the data generated are also becoming complex. This paper focuses on Mobile GPS real time data streams generated by the mobile devices all over the world. Based on that we are building a recommendation engine based on analyses of mobile GPS data that provides real time services to users based on patterns of activities being done by users in recent times. We propose a collaborative location and activity filtering recommendation engine, providing real time services to users, by filtering out, the service consumers and service providers, and shake hands between them to get benefited. We study and evaluate UNAVCO's real time GPS data streams taken from a subset of PBO having GPS data streams from more than 1100 stations that is available in different formats and provide different analyses of the GPS data.

Keywords: BKG Ntrip Client(BNC), RINEX, BINEX, GPS, RCTM.

I. Introduction: Likewise we want to explore new areas to reach out, we are proposing a technique where real world meets their needs dynamically in real time. This is meant to fulfill the user needs at present, by analyzing their patterns of activities in past. Mobile devices including smart phones, GPS devices are so ubiquitous that retrieving evidence from them is not so simple [10].There's need to get the data from different trajectories and GPS Satellite and Stations from all over world. This is meant to unite the world needs in real time, by learning the local user's traces and activities. We got the Real time GPS data stream from UNAVCO (University Navstar Consortium)that broadcast streaming GPS data, taken from subset of PBO stations. This provides Real-time 1Hz streams from selected 1100 PBO stations and are available in BINEX (Binary Exchange), RTCM 3.1 (Radio Technical Commission for Maritime) formats via NTRIP(Networked Transport of Radio Technical Commission for maritimevia Internet Protocol). We convert this

Stream to RINEX (Receiver independent exchange format) using UNAVCO's teqc utility. This provides standard GPS observable data time series from the receiver [1]. 1-Hz RINEX real-time data for previous day can be accessed with the GPS/GNSS Data Archive Interface, orit can be 1-HzRINEX real-time data for earlier hours or for previous days can be accessed directly via GPS/GNSS ftp server[2]. The software we used for getting data, decoding it, transforming, processing andanalyzing this GPS real-time data streams is BKG Ntrip Client (BNC) using the Ntrip standard. This is developed byIAG sub-commission for EUREF in Europe and the IGS. This real-time BNC tool, have some post-processing functionality and is an Open Source multiple-stream client software designed for variety of real-time GNSS/GPS applications. Initially, it was designed for receiving GPS data streams from any Ntrip supported Broadcaster. Now, the program also handles the HTTP communications and transfers received GNSS/GPS data to serial or IP port with networking software. This can compute real-time Precise Point Positioning (PPP) solution taken from RTCM streams or RINEX files. Last year's BNC has been enabled with RINEX quality check and editing functions. We can run BNC client with GUI as well as in CLI/batch processing mode. We have usedrtgpsout.unavco.org Ntrip Broadcasters for getting in data.

In this, we are going to take a stream of data in the form of RTCM 3.1, decoding this data, and converting it to RINEX which provides observation and navigation files, with other features including quality check.

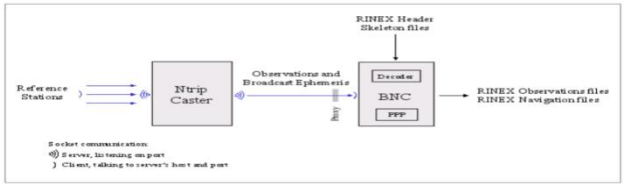

Figure 1: Conversion of RTCM streams into RINEX files.

Every Stream on Ntrip Broadcaster is defined using a unique source ID (shown in fig 2) called mountpoints. BNC accesses the stream by referringto its mountpoint. This information of streams and its mount points are available in the provided source table that is being maintained by respective Ntrip Broadcasters.

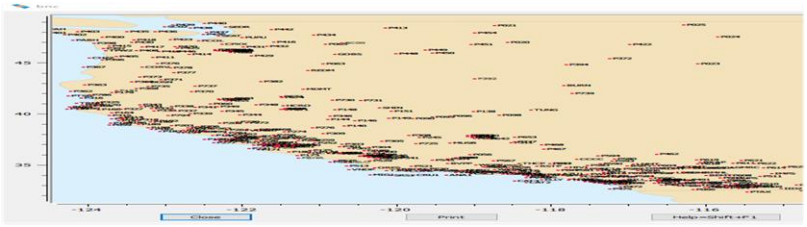

Figure 2: Map showing GPS Stream distribution by BNC derived from Ntrip source-table.

These GPS data streams we get from rtgpsunavco.org, providing IP address, IP port number, specifying stream format, with the username Id, and password, made us available more than 1700 real time GPS data Streams.

Further we can make it available through caster, TCP/IP, UDP port or Serial port.

Figure 3: Log Canvas recording BNC activities.

'Log' tab i.e. part of 'Log' canvas which maintains record of all the BNC activities. In Log Canvas, 'Throughput' is consumption of bandwidth per stream, and 'Latency' tab shows latency of incoming observations. And another tab, 'PPP' in canvas - (Precise Point Positioning)shows the time series for all coordinate movements/displacements, and also provides control of all theBNC's activities being performed.

In these log tabs, first one showing Throughput, providing the bandwidth consumption per RCTM stream that is in bps or kbps. 'Latency' providing latency of observations of each incoming stream in milliseconds or seconds. Streams having an outage or not carrying observation are not to be considered. The clock of the local system should be properly synchronized for the calculation of correct latencies. Precise Point Positioning(PPP) shows the time series ofUp(blue), North (red), East (green) coordinates, providing real time displacement of Mountpoint. The time in PPP is provided in format of [hh:mm] that refers to current GPS Time and covers a period of 5 minutes in its sliding window.

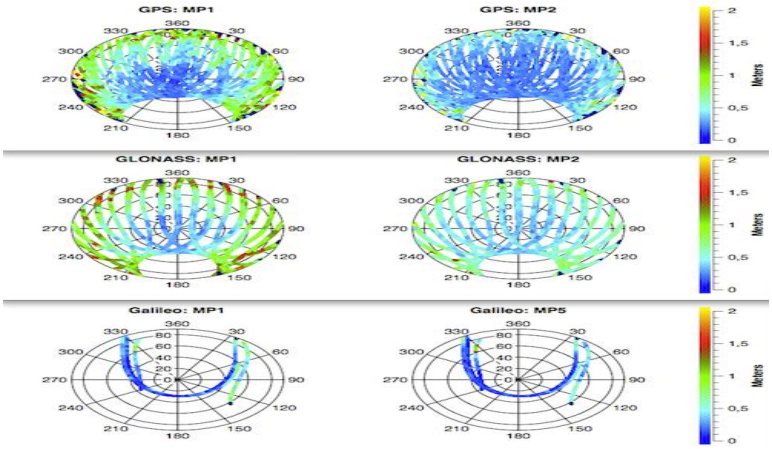

Fig 4: Multipath analysis sky Plots.

By means of multipath analysis, this sky plot checks the quality of RINEX file. Results generated are being saved on disk as plot with PNG format.

As per the GNSS system, Multipath and signal-to-noise sky plots are generated and this CnC observation type i.e. (n = band / frequency) takes care offrequency of multipath analysis.

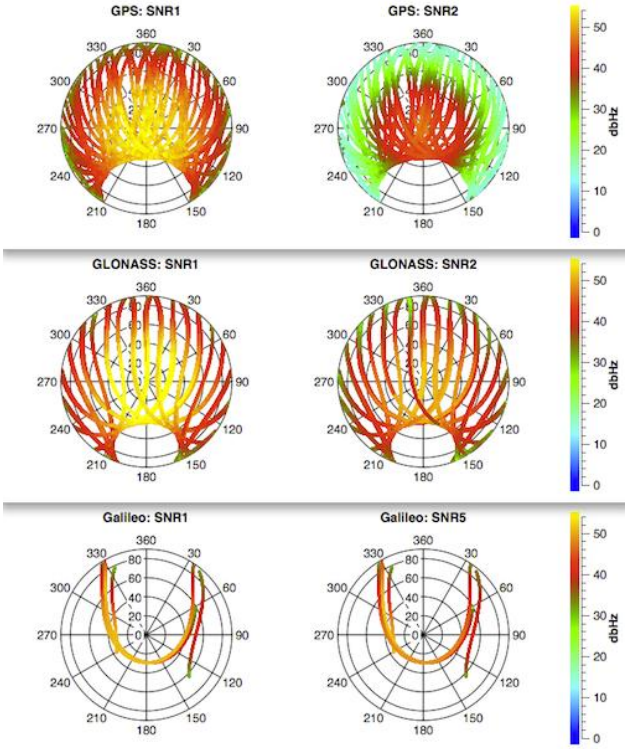

Figure 5: Signal-to-noise ratio sky plots.

This analysis with BNC is a part of RINEX quality check by means of signal to noise ratio, i.e. the ratio of strength of an electrical signal carrying some information to that of unwanted interference generated. Or, this tells how much relevant information is present in this data.

All these provides with the analysis of the GPS data stream processed by the BNC, we can now see the plot of our GPS stream on to the map, getting it exact location and the displacement. How much data it is consuming i.e. throughput, and what is its latency. All these completes our first stage for moving towards the real time analysis of mobile data. We can track the actual movements of the user, analyzing their activities, and providing them real time support. Also there's we have potentialities to keep track of their health records, by analyzing how much steps they have taken in their daily activities, and how much calories they have burnt. Before going to all these, we can see the real time data stream on the

Open Street Maps, figuring out the actual location of the data stream, noting down their latency and throughput, and distance they are covering.

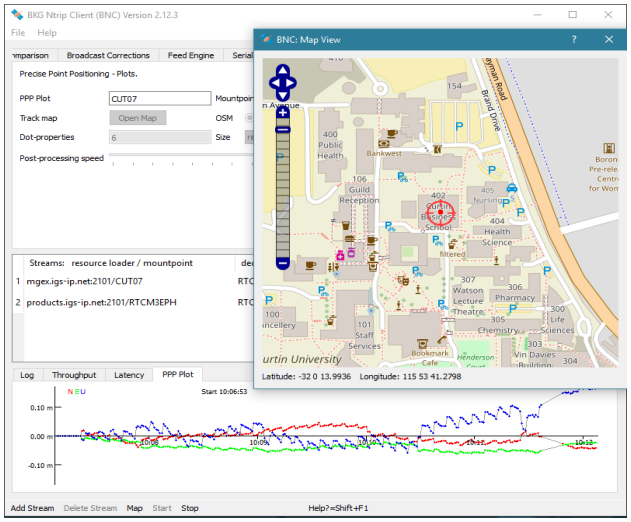

Figure: 6. Tracking positions from BNC with Open Stree Maps.

We can now analyze the current position of the node by their sourceId, we can measure out the distance is being covered by the node, realizing their current activities, locations they are visiting, figuring out their behaviour. This provides us with real time analyses of mobile data.

Figure 7: red colored dot PPP tracks are presented on map.

Precise Point Positioning from RTCM or RINEX files derives the plot positions shown on map, i.e. from Google Map or OpenStreetMaps. Track plots are produced with BNC in 'Real-time PPP', 'Real-timeSPP' and 'Post-Processing' PPP mode.

II. Challenges

Restricted access to the data. The data is protected by certain formats that cannot be imported to other devices or programs.

The data that recommender systems deals with is not as complex like mobile data. This mobile data is noisy, heterogeneous, spatial data,having validations and also generality problems[3].

Limited data from GIS Trajectories. The data we collected is not that much ideal for dealing with and modeling space-time activities and having limited accuracy [4].

Conversion of GPS Data Stream from RINEX or BINEX form to machine understandable, so to make out analyses from multi-dimensional data.

Configuring the consumers and providers out of clusters of GPS nodes, and then applying machine learning collaborative filtering recommendation so to match out patterns, for both type of users.

Also needs User interface, where users can see bunch of providers and can configure out the one who is ready to shake hands. Or both the parties satisfy their needs and can benefit out of it.

III. SCOPE

This real time data if used to build a recommendation engine, by analyzing the users real time location and activities continuously for some period of time, learning the patterns made out of the users activities, learning their behaviour and activities, and using collaborative filtering technique to build machine learning recommendation engine, which learns what user do, where they go and what they need at particular period of time, by accessing their real time locations, matching their patterns of activities, recommending the users the serviced they can get, so to ease the task of both the consumers and service providers, and providing real time access. This is location based service, having some limitations like, you can not recommend a user mode of transport which is not available in city. Or something like, you can't recommend a user, ingredients required to make recipe, which is not available in that area. So it is truly location based real time service provider. Having some limitations, but is very effective when used properly. This recommender system uses hybrid approach, not only based on one user activity, taking the cluster of users, having same patterns of activities being performed, and recommending the user, the similar type of service. This Location based recommender system also provides service to the users who are new to city. Based on the learned activities performed by the similar type of users,

this recommendation engine will recommend similar service, based on user's interest. Likewise, someone is new to city, wants to go to restaurant, our recommendation engine will recommend the best recommend based on history of data it have learned and updates its system every time, so that they can be provided better service each time.

Moreover, this real time GPS system, can help find out the traces of criminals or malicious activities being going on in city. This can help in fraud detection.

This recommendation system will also offer profitable driving routes to taxi drivers in the city, taking data from GPS traces, that often taxi drivers take, and providing longitude and latitude, time stamps and operational status. The recommender system learns this data, recommending or suggesting the list of pickup points and their routes, optimizing occupancy time and profitability[5].

Also, it can keep tracks of your daily health and provide real time statistics of your daily activities, also recommend users enhancements to their health, by providing benefits, available in their nearby locations. This System can have many potentialities and can be a research topic.

IV. Acknowledgement

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