***Geoinformatics Project, 2021***

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| **GNSS (GPS) DATA PROCESSING**    **GROUP MEMBERS** | | |
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**Abstract**

GNSS Point positioning involves measurement of the signals emitted by a satellite for the determination of the position of a receiver on the surface of the Earth. The emitted signal contains information about the ephemerides and clock offset of the satellite. The signal propagation through the atmosphere is delayed by the presence of free electrons in the ionosphere (about 100 and 1000 km altitude) and the water vapour content of the troposphere. These delays affect the precision in the estimated position of a receiver. However, for a double frequency receiver, the combination of both L1 and L2 frequencies of the signals resolves the effects of the ionosphere.

The GNSS Data Processing Software (GDPS) has been developed along with other libraries for determining the ephemerides of a satellite by reading the navigation message file of a GPS satellite. Additional models have also been developed for estimating the ionospheric effect at a user station, with respect to the elevation and azimuth of a Satellite Vehicle. The implemented algorithms are as defined in the IS-GPS-200L (Sections 20.3.3.4.3 and 20.3.3.5.2.5 respectively).

A Graphical User Interface has been developed to enable a user access the models. Detailed description of how to use the software are described in the next pages.

The main language used for the exercise is Python.

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**Introduction**

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A Graphical User Interface has been developed to enable a user access the models. Detailed description of how to use the software are described in the next pages.

The main language used for the exercise is Python.

Objective

Tools

Spyder

Phyton Libraries:wx, matplotlib, cartopy, astroplan, tabulate(diff), datetime, numpy

Ours: read\_rinex, sat\_orbit, ionosphericcorrection, cart2geod, geod2cart, rotation

Rinex file

Interface

Results

Orbit

Graphs example

Azimuth and elevation

Ionospheric correction

Testing

#from differences.py

**GNSS DATA PROCESSING SOFTWARE (v1.0)**

GNSS Point positioning involves measurement of the signals emitted by a satellite for the determination of the position of a receiver on the surface of the Earth. The emitted signal contains information about the ephemerides and clock offset of the satellite. The signal propagation through the atmosphere is delayed by the presence of free electrons in the ionosphere (about 100 and 1000 km altitude) and the water vapour content of the troposphere. These delays affect the precision in the estimated position of a receiver. However, for a double frequency receiver, the combination of both L1 and L2 frequencies of the signals resolves the effects of the ionosphere.

The GNSS Data Processing Software (GDPS) has been developed along with other libraries for determining the ephemerides of a satellite by reading the navigation message file of a GPS satellite. Additional models have also been developed for estimating the ionospheric effect at a station, with respect to the elevation and azimuth of a Satellite Vehicle. The implemented algorithms are as defined in the IS-GPS-200L (Sections 20.3.3.4.3 and 20.3.3.5.2.5 respectively).

A Graphical User Interface has been developed to enable a user access the models. Detailed description of how to use the software are described in the next pages.

The main language used for the exercise is Python.

**DEFINED LIBRARIES**

The main libraires are being used in the Main.py file are

* IonosphericCorrectionSF.py
* sat\_orbit.py
* read\_rinex.py which contains the methods
  + readIonosphericParamters( )
  + read\_nav( )
  + getSatellitePRN ( )
* Cart2geod.py
* RotationParam.py
* Rotation.py

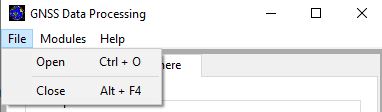
Other olibraries defined but not used include

* ClockCorrection.py
* Deg2rad.py
* Ecef2eci.py
* Geod2cart.py
* GeometricRange.py
* GPStime.py
* IonosphericCorrectionDF.py
* L1\_L2Corection.py
* PseudoRangeIonoCorrection.py
* Rad2deg.py
* RelativisticEffects.py
* SaastamoinenModel.py

**How to install the software**

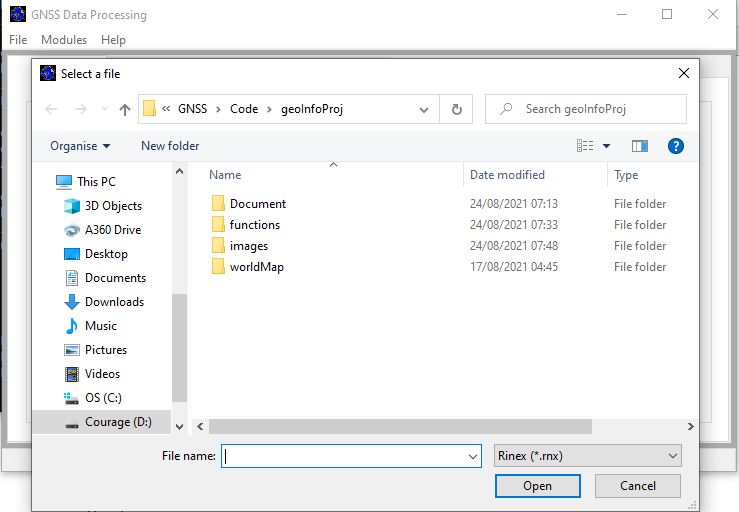
**Menu Items**

* The File menu contains the items Open and Close.

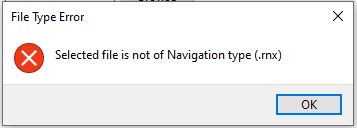




The Open menu item is needed to open a GPS Navigation message file (.rnx) before the main functionalities can be accessed (Figure ………..).



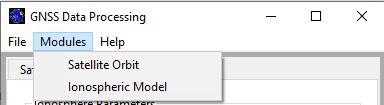
When the file is not of the type ‘.rnx’, an error message is printed to the user as shown in Figure ……….. defining the error and by closing the dialog, the user can select the required file type.



The Close menu item exits the main window of the GUI.

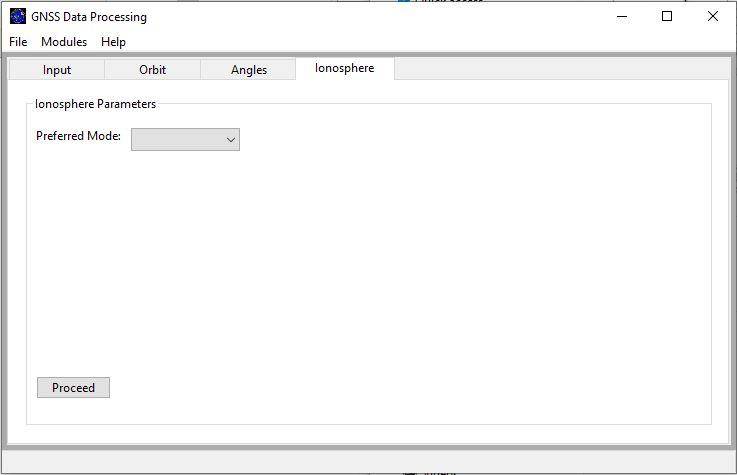
* Modules

The Modules menu shows the main functionalities (Satellite Orbit and Ionospheric Model) for the software.

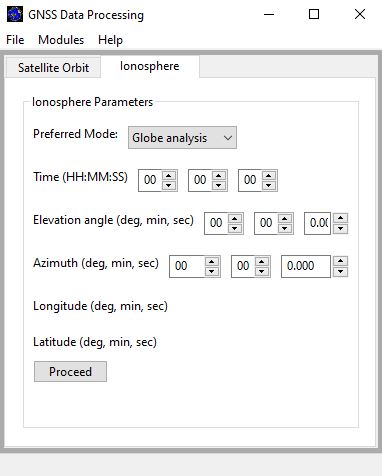


The Satellite Orbit item gives navigation to the Orbit panel.

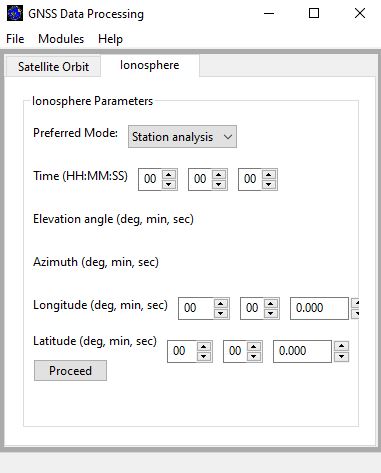
The Ionospheric Model navigates to the Ionosphere panel where the paramters needed for performing the Ionosphere computation are needed. On this panel (Figure ………………..), the user selects the preferred model (Station analysis or Globe analysis).



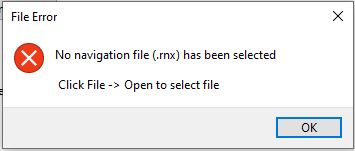
By selecting the Globe aanalysis, the panel is updated, exposing the buttons for inserting the paramters (time, elevation and azimuth), Figure …………………. The default values in the buttons are zeros and the user can change the values. Also, only numerical values can be entered in each button. By clicking on the ‘Proceed’ button, an Ionospheric Error map is produced showing the variations in the ionospheric effects on the globe.



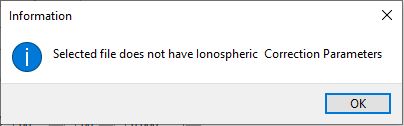
By selecting the station analysis, the panel is also updated (Figure ………..), exposing the buttons for inserting the parameters (time, longitude and latitude) required for the model. Also, the default values in the buttons are zeros and the user can change the values. By clicking on the ‘Proceed’ button, an Ionospheric Error map is produced showing the variations in the ionospheric effects on the globe.



In both instances of Global and station analysis, when a GPS Navigation message file has not been selected, the user is informed of the unavailability of the Rinex file (Figure ……………..) and given a guide to select the file.

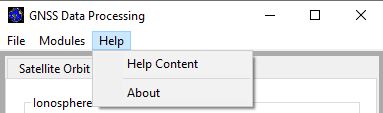


Also, when a file is selected and there are no ionospheric error correction parameters in the file (Figure ……………..), the user is also informed of such and can select another file.



* Help

The Help menu (Figure …..) shows the Help Content and About items.



The Help Content gives a brief description on how to use the software as well as an introduction to the models used in the software.

The About menu item shows the About page (Figure ….) which gives a brief description to the about the project.



For easy access, shortcuts have been created for access shown in the table below

|  |  |
| --- | --- |
| **KEY SHORT CUTS** | **DEFINITION** |
| Ctrl + O | Open |
| Alt + F4 | Close |
| Ctrl + K | Orbit panel |
| Ctrl + I | Ionosphere panel |
| F1 | Help contents |

**Data Processing**

Figure …………….. shows a sample output map for a global and station ionospheric error analysis respectivley. With regions of higher ionospheric error at the time shaded red and regions of lower ionospheric effects shaded blue.

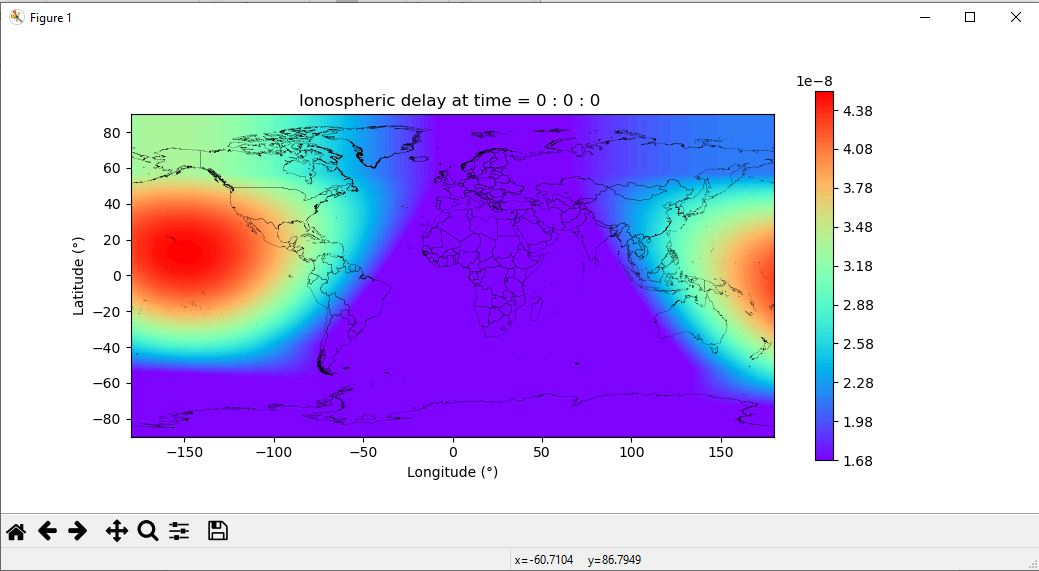
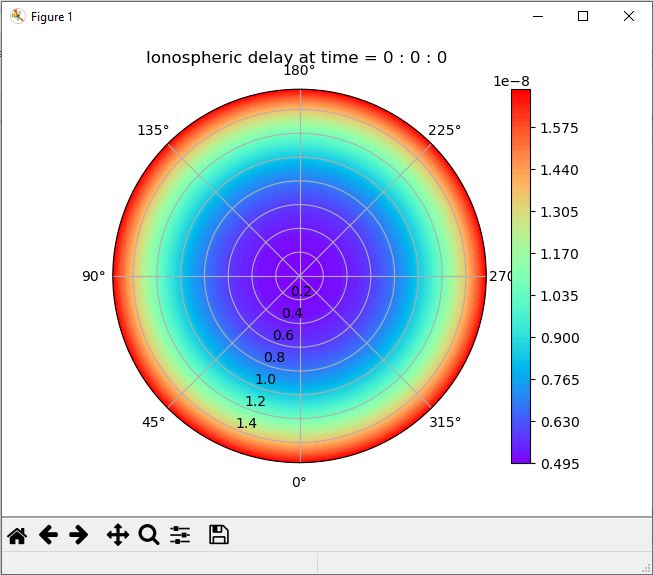


Figure ………………………. Shows a sample output map of the varation of ionospheric error for varying elevation and azimuth. From the graph, it is more clear that the ionospheric error is higher for lower elevation of the station with respect to the satellite vehichle.



**/// Update the readme on libraries to install to use the program**