ionFR: User Guide

Version 0.0

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General Information

This manual will show you how to use the `ionFR` package.

1 Introduction

`ionFR` is a software package that allows to estimate the ionospheric Faraday rotation along a given line-of-sight (LOS) at a specific geographic location. The software uses the last release of the International Geomagnetic Reference Field (IGRF11) and global ionospheric maps given in the IONosphere map EXchange format (IONEX)[1]

`ionFR` has been written almost entirely in the Python language. This software package has been proven to work well under the Ubuntu operating system.

This is the first edition of this manual, and therefore the first version of `ionFR`. Some bugs which have not been still detected by the author are likely to be detected by the users. Hence, they are encouraged to report these flaws to: `sotomayor@astro.rub.de`. Suggestions or comments which the users think will make better this code are also very welcomed.

2 Getting Started

One you have installed `ionFR` in your computer[2], you will be able to run it easily from the terminal.

To test the package, open a terminal and copy the IONEX file `CODG1400.04I`, located in `ionFR/`, to your current working directory. Then, type:

```
$ionFRM.py 16h50m04.0s+79d11m25.0s 52d54m54.64sn 6d36m16.04se 2004-05-19T00:00:00 CODG1400.04I
```

The command will produce a .txt file, `IonRM.txt`, which will contain ionospheric Faraday rotation values along the given LOS in steps of 1 hour during an entire day. More on what this file contains is given in the subsection 2.2.

2.1 Arguments taken by ionFR

The script `ionFRM.py`, located in `ionFR/`, is a wrapper that calls serveral functions embedded in the three code that aid in predicting the ionospheric Faraday rotation. This wrapper takes on five arguments.

- *RA*±*Dec*
  Right Ascencion and Declination of a given LOS.
  `16h50m04.0s+79d11m25.0s` (positive dec.)
  `16h50m04.0s-79d11m25.0s` (negative dec.)
- *Latitude*
  Latitude of the location where a given LOS is being observed.
  `52d54m54.64sn` (lat. north)
  `52d54m54.64ss` (lat. south)

[1] IONEX files provide global TEC values. For more information have a look at: `http://aiuws.unibe.ch/ionosphere/`
[2] See the README.txt file within the package root directory, `ionFR/`, for installation instructions

– *Longitude*
Longitude of the location where a given LOS is being observed.
`6d36m16.04se` (lon. east)
`6d36m16.04sw` (lon. west)

– *Date*
Date for which you want to predict the Ionospheric Faraday rotation.
`2004-05-19T00:00:00` (YYYY-MM-DDT00:00:00)

– IONEX *file name*
Name of the IONEX file needed. There is a script, in the directory `ionFR/IONEX/`, called `IONEXFileNeeded.py` which allows you to know the name of the IONEX file you need for a given date.
`CODG1400.04I`
IONEX files are available since 1994 at: `ftp://ftp.unibe.ch/aiub/CODE/`

2.2 Output produced by ionFR

As mentioned above, a file called `IonRM.txt` will be created in the folder where you ran the test. This file contains five columns:

– 1 → Hour of the day in Universal Time (UT)
– 2 → TEC along the LOS
– 3 → Geomagnetic field along the LOS
– 4 → Ionospheric Faraday rotation along the LOS
– 5 → Error values of the asociatted Ionospheric Faraday rotation values in column 4.

`ionFR` will produce values only for elevations higher than 0°.

3 What to expect?

A simple way to visualize better the prediction the software produces is by making a plot. For this the file resultant after running the test was used. Time vs. ionospheric Faraday rotation can be seen in Fig. 1. Error values were obtained from column 5 in the file `IonRM.txt`.

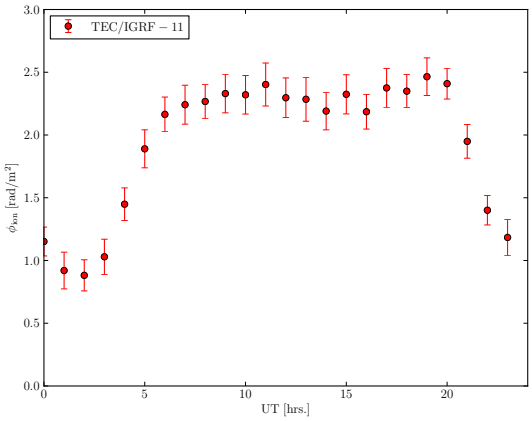

Figure 1: Ionospheric Faraday rotation predicted for the May 19, 2014 along the LOS with RA = $16^h50^m04.0^s$ and Dec =+79°11′25.0″)