Mission Space Lab Phase 4 Report

Team Name: AstroVitruvio

Chosen theme: Life in Space

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Introduction

How reliable is magnetic field data collected from Raspberry Pi on the ISS? We wish to analyze and compare it to computer simulated values, based on the current World Magnetic Model (WMM), at the same height as the ISS, about 400 km above Earth surface. We hope and expect to notice some incongruities from the comparison. If this is the case, we will verify whether the change in the magnetic field is an early consequence of earthquakes.

Method

The Python code we ran on the ISS between 9th and 10th April read data from the Sense HAT every 3 seconds and wrote it into a CSV file. We collected date, time, magnetometer and accelerometer components, as well as geographic coordinates (using the "ephem" Python library). Code is available at github.com/CoderDojoTrento/astropi-19-20/tree/master/astrovitruvio

Using the platform "uMap" we were able to map the trajectory of the ISS during our code run-time (umap.openstreetmap.fr/en/map/astropi-2020-astrovitruvio_460982#4).

Figure 1: ISS orbit during the experiment

We also downloaded magnetic field data from the WMM (through Web API request in Python) (https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml?#igrfwmm) using as input longitude and latitude we got from our code on the ISS.
For both data sets (ISS and WMM) we calculated the total intensity of the magnetic field from its components $B_{tot} = \sqrt{{B_x}^2 + {B_y}^2 + {B_z}^2}$ in order to make a comparison. To do so, we plotted both intensities using Matplotlib, a Python library.

Results

Plotting the two data sets we noticed much more than some incongruities, our data seemed off all the way through.

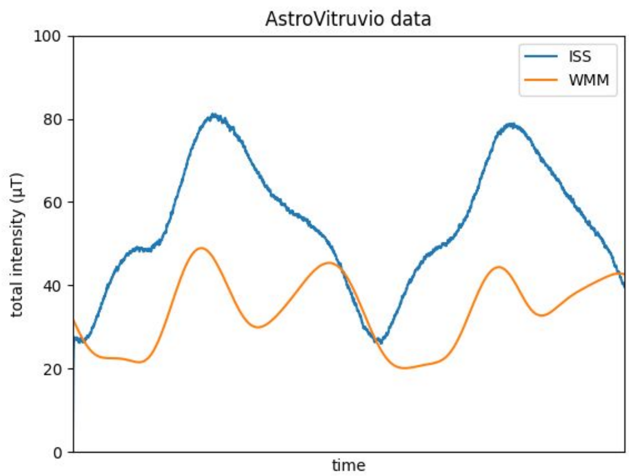

Figure 2: Comparison between AstroVitruvio and WMM total intensity

There were two possible scenarios: either ISS or WMM data are not reliable.
So we decided to borrow data from another group (GretaInTheSpace, our schoolmates, whose code ran on 21st April) and compare it once again to WMM simulated ones, to find out if they had the same problem as we did.

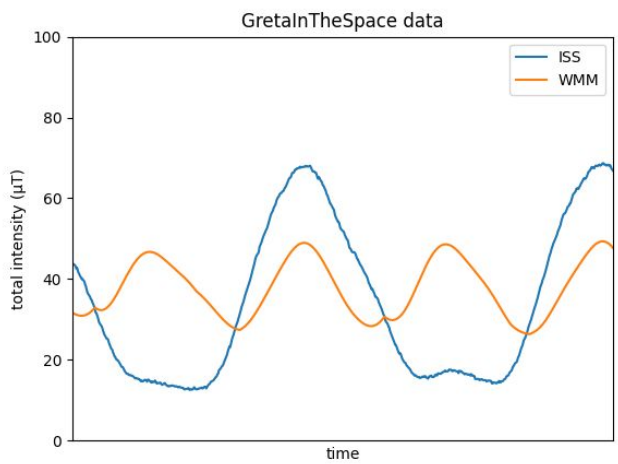

Figure 3: Comparison between GretaInTheSpace and WMM total intensity

The second graph we obtained revealed an outstanding result: despite GretaInTheSpace's data having a different behaviour than WMM's, we noticed that the shape of its graph is similar to what we have looked at reading previous years reports.

To highlight the difference between the two groups' data we plotted the ratio between ISS intensity and WMM intensity. It's clear that a higher ratio denotes a bigger "data error": in our experiment the ratio is fluctuating, in fact it has high maximums but also values around 1. For the other experiment the results are very different, the average value is around 1, which is what we expect from simulated data.

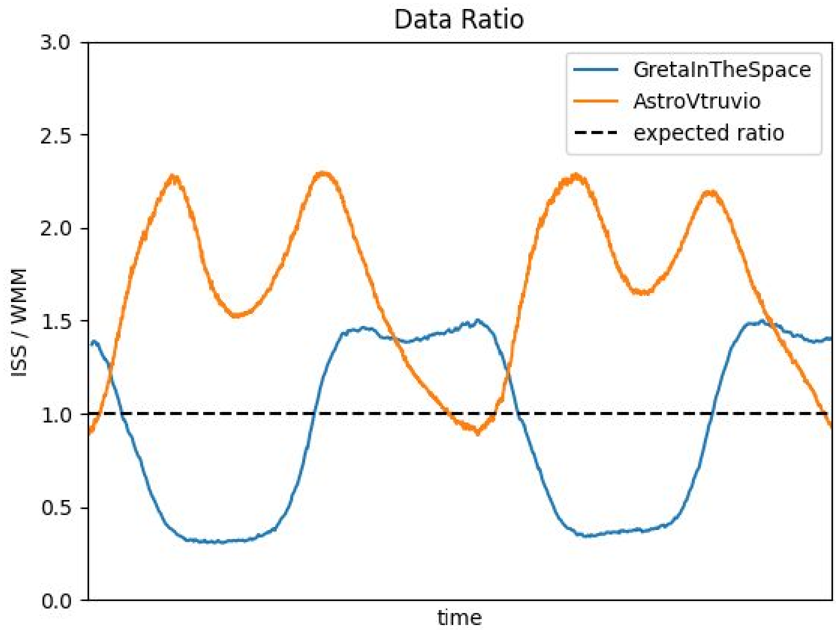

Figure 4: Comparison between AstroVitruvio's and GretaInTheSpace's total intensity ratio

Conclusion

We were unfortunately not able to conduct an analysis on earthquakes and their effects on Earth's magnetic field due to a lack of accuracy of our data. We suppose this was caused by either a wrong calibration or the presence of an unknown source of magnetic field close to the Raspberry Pi. We excluded the presence of Solar storms, because during our code's run-time there were not any; from the official NASA website we also found out about a new docking by the Soyuz spacecraft, but it was on the complete opposite side of the ISS compared to the location of the module Columbus, where the Raspberry Pi is located, so it is unlikely that it had been affecting our measurements.
To conclude, we would like to point out the complexity of modelling real-world phenomena such as Earth's magnetic field. Experiments like ours help the development of such models leading to a better understanding of the world around us.