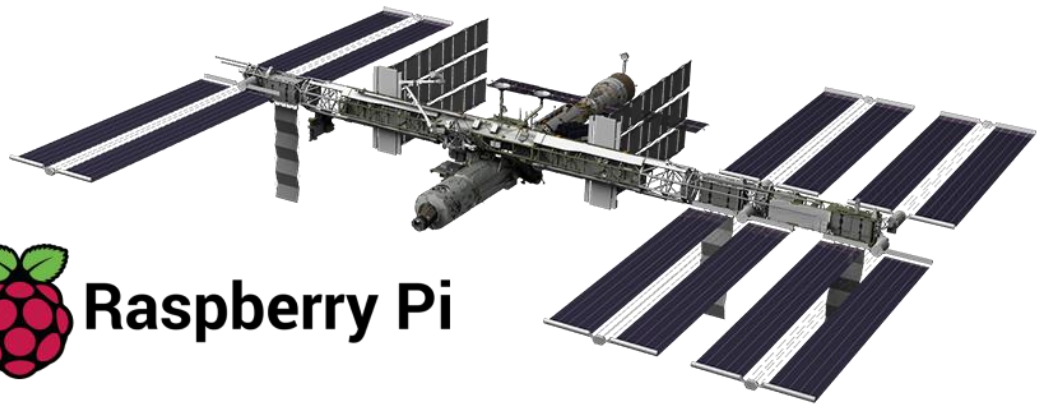

The effect of the conditions on the ISS on astronauts

Team Name: BPC_Pi
Chosen Theme: Life in Space
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Introduction

Our AstroPi experiment aimed to investigate the conditions on the ISS and see if they would have any effect on the astronauts in the long term. We thought that this subject was interesting because they spend a lot of time doing complicated experiments, and maybe don't have quite enough time to think about their wellbeing.

Even though we expected to find a safe environment for them, we still found the data interesting, and it was definitely a pleasure to participate, and be able to run an experiment on the ISS.

Method

Our code was in charge of data gathering. We measured everything from the environmental conditions (using the Temperature, Humidity, Pressure sensors) to Acceleration and Direction (Accelerometer and Gyroscope Data) and the distance between the ISS and the earth, using Ephem [0].

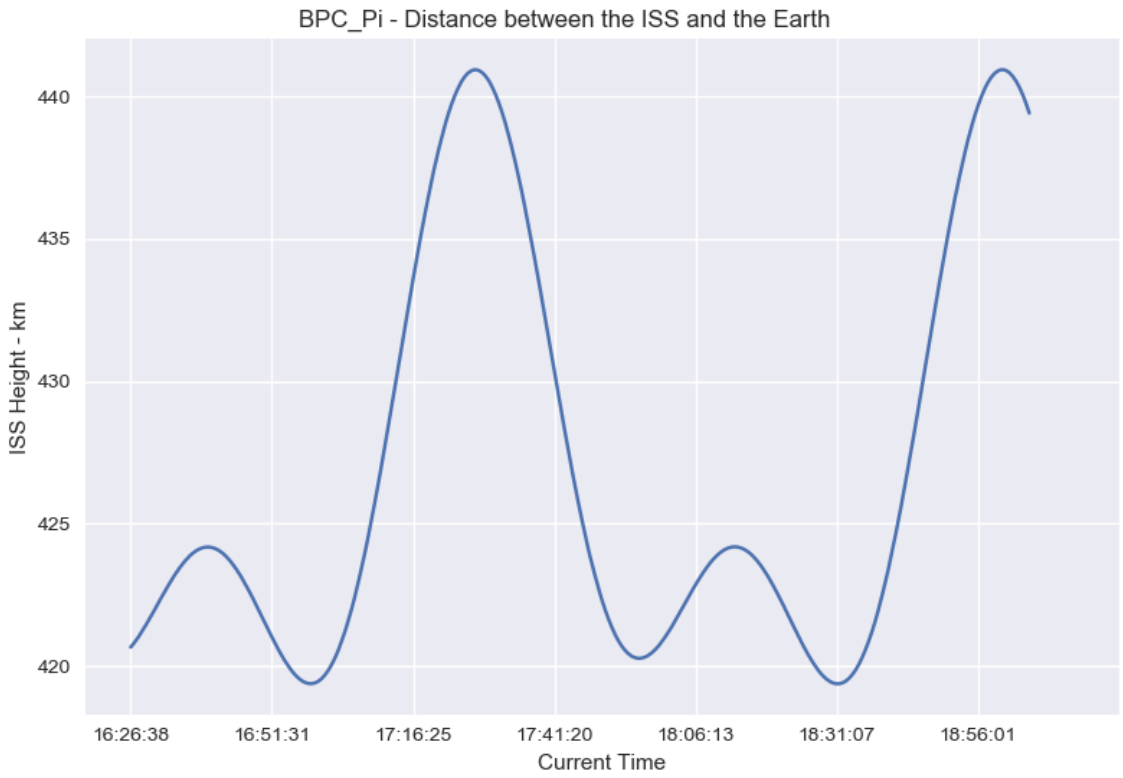
We collected the data in a .csv file that we then parsed using Python and used Matplotlib [1] to plot graphs using the received data

The only disadvantage was that since the Pi's sensors were inside the case, the data might not be exact, but it is inside a reasonable margin of error.

Results

Analyze no 1 – The ISS Height

Graph:



With the graph we were able to observe subtle, but rapid and regulated changes in the ISS Height, and we actually couldn't find any info on this, as we don't think these are re-boosts, so we think it has something to do with the South Atlantic Anomaly, but we would still be very thankful for a more "official" response.

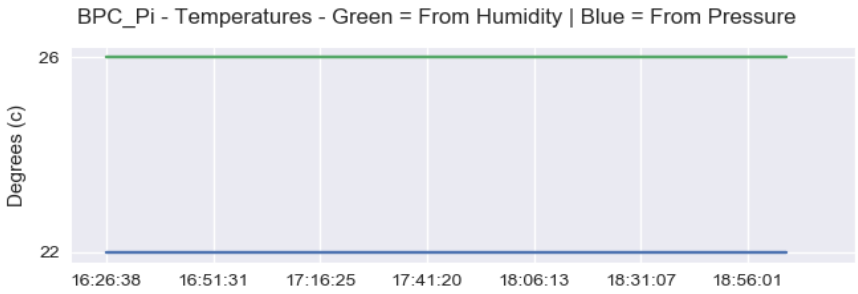
An important aspect of the ISS Height is the effect of the sun radiations on the astronauts. During the research for this report we found out that there is a special team that is dedicated to measuring crew exposure – the Multilateral Medical Operations Panel – tracks the radiation and also set the standards/limits for crew radiation exposure [2].

To conclude this sections, given that the astronauts have a career limit of 1 Sievert of radiation, which is a quite high amount, given that one Sievert comes with a risk of 5.5% of developing cancer, but also in a typical day, you would receive ~3 millisieverts of radiation normally in a year, or in a CT (abdomen) 20 millisieverts [3], so given that in a mission (6 months) they would receive around 500 millisieverts (according to src 3), so about 25 CTs, which should not pose any danger to the astronauts even in the long run, even more so when you consider that the MMOP also actively measures radiation and ensures that the astronauts are safe.

Even though initially we only wanted to get this data, for our curiosity, at the end of our research, we found that the position(height) of the ISS, does not pose a significant risk on the astronauts and is quite important for a lot of experiments, but one that caught our attention was LAZIO [4], with its study about magnetic waves.

Analyze no 2 – Enviormentals – Temperatures:

Graph:



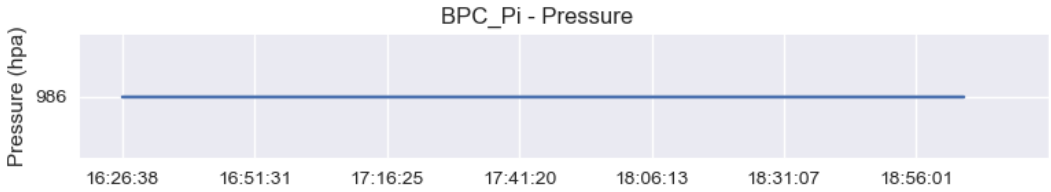
As to be expected, the temperatures were constant, with an average from what we gathered of around 24C.

This is quite close to the ideal temperature of around 20-22 Celsius [3] – for a place where you're supposed to work, and we should consider a margin of error, given the temperature sensors are inside the Pi Case, and they are probably recording a couple degrees higher than actual.

There shouldn't be any effect to the astronauts, as, like we said previously, it is fairly close to the ideal temperature.

Analyze no 3 – Enviormentals – Pressure:

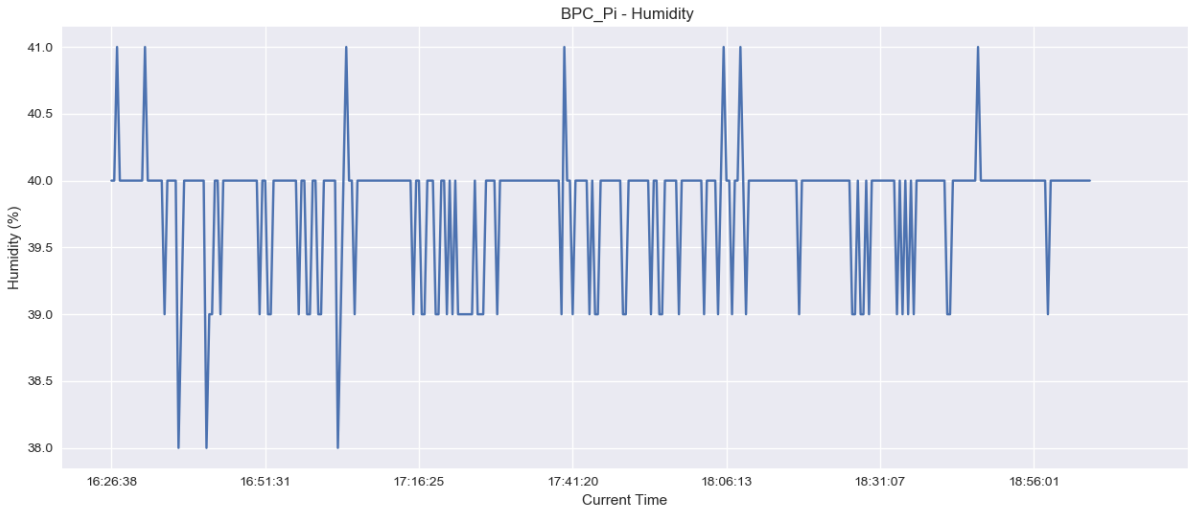
Graph:



Once again, the pressure was constant (almost annoyingly so), but it was to be expected from such a strictly regulated space, and well within normal levels.

Analyze no 4 – Enviormentals – Humidity:

Graph:



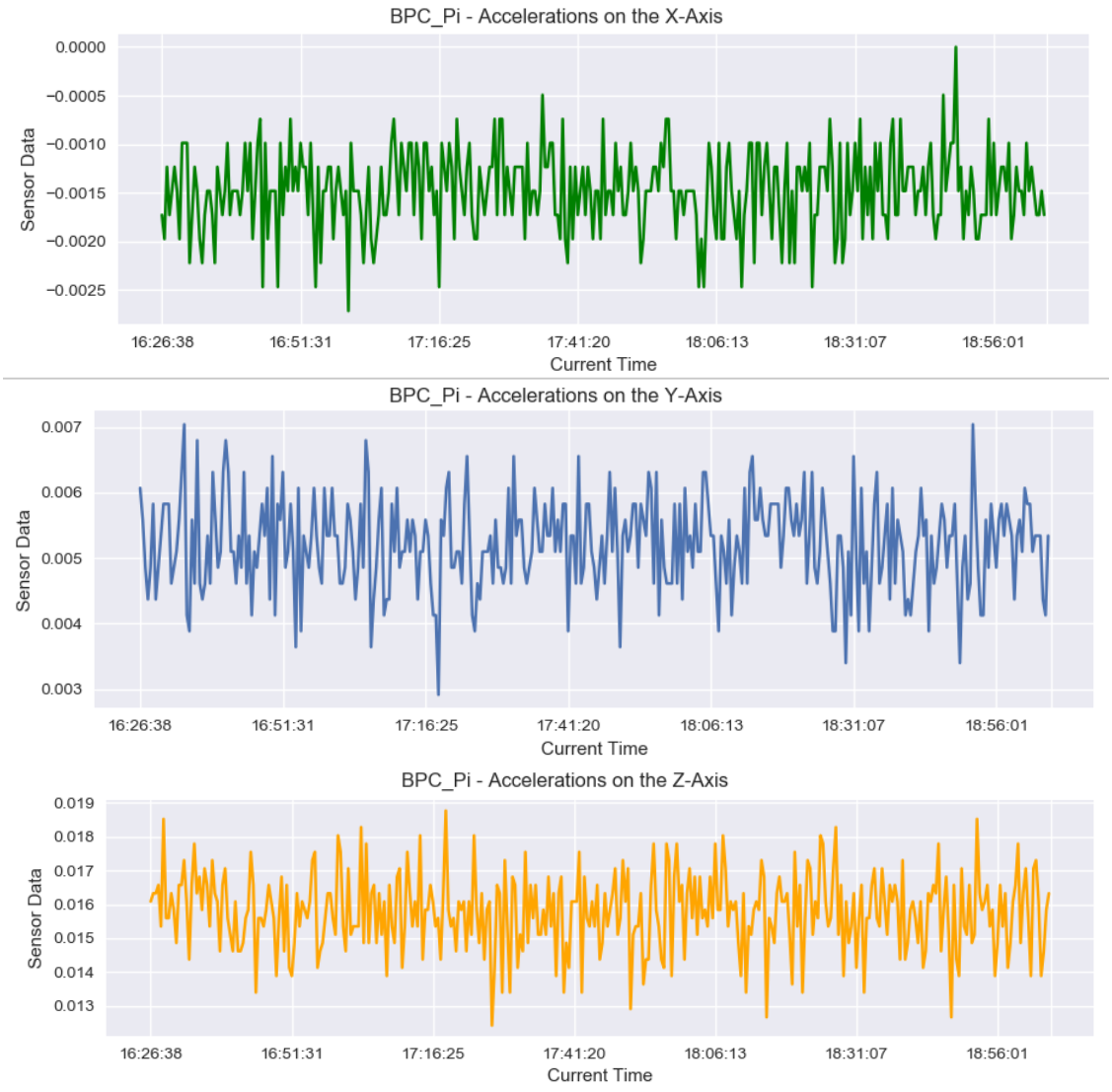
The Humidity, was the one environmental factor that actually changed the most during our experiment.

From the graph we can see small pikes, of short duration, of the humidity, that, we think are because of an astronaut passing by, or maybe being near the Pi, especially during the spikes at the beginning 16:26 and at 18:06.

We are going to be comparing the data to normal levels for a house [6]. For houses it is suggested to maintain a level of around 45-55% as to avoid health effects and illnesses. On the ISS the humidity was around 38-41%, which (according to src 6) would still be in the comfortable range, and also it is probably better for the computers onboard and for the experiments to have a lower humidity.

Analyze no 5 – Accelerations:

Graphs:



We can see that on both the x-axis and the y-axis that the values are almost (especially on the y-axis) null, and on the other hand on the z-axis there is a lot more activity, and that is what we expected to happen because of the orbital motion of the ISS.

Overall, we were able to find that the accelerations supported by the astronauts are not anywhere near high enough to make them uncomfortable, even in Zero-G, never mind have any effects on a longer period of time.

Conclusion

In the conclusion, the data is what we expected. We have concluded that the astronauts are safe aboard the ISS, as long as their stay isn't longer than 5-6 months, mostly due to the solar radiations in space (also due to the Zero-G environment, but that wasn't part of our experiment). We did expect the conditions to not majorly affect the astronaut's life on a longer term, because of all the development of the ISS to make sure it is a safe location for the astronauts and for the experiments.

If we were to conduct a more in-detail experiment, focused on measuring solar radiation we would use a Geiger counter in order to properly measure the radiation. Also if we wanted to properly measure the environmental data, we would use external temperature, humidity and pressure sensors, to rule out any errors caused by the Pi's CPU temperature inside the case.

References / Licenses

[0] - https://pypi.org/project/ephem/

[1] - https://matplotlib.org/

[2] - https://www.forbes.com/sites/quora/2018/11/13/how-much-radiation-are-iss-astronauts-exposed-to/#66469f7b18a9

[2.1] - https://en.wikipedia.org/wiki/Sievert

[3] - https://www.radiologyinfo.org/en/info.cfm?pg=safety-xray

[4] - https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Eneide_-_Vittori_mission/Observing_Earth_s_magnetic_field_from_ISS

[5] - https://www.viessmann.co.uk/heating-advice/what-is-the-ideal-room-temperature

[6] - https://www.centralhtg.com/blog/managing-home-humidity-for-maximum-comfort

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General info about the ISS:

Wikipedia: https://en.wikipedia.org/wiki/International_Space_Station

ISS Articles – ESA: https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/International_Space_Station

Some more ISS Info – NASA: https://www.nasa.gov/mission_pages/station/main/index.html

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