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ATON

Ground Control Software for the ATON Stratospheric Platform.

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Abstract

This software has been developed in order to receive, graph and visualize within a Graphical User Interface on ground, telemetry data and images form the ATON stratospheric platform so as to know the behavior of this platform. Also it is capable to receive commands to perform actions during flight.

Introduction

This Ground Control Software, which is part of the development of the ATON stratospheric platform has been developed by the Space Instrumentation Laboratory (LINX-ICN-UNAM).

This is the second revision of the software, whose intention is to implement a lighter version, capable to work on any computer capable to run Python.

Also it is intended to implement additional capabilities, such as the image reception and the transmission of commands.

About the development

This software has been developed by using free software, specifically the Python language and its libraries (matplotlib, drawnow, pygame), to implement and debug the code in the Ubuntu operating system, with the main goal of having the capability to run in any computer with the Windows operating system and in most of the Linux distributions (Ubuntu, Fedora, Debian, etc.).

python + Linux

The main objective of this software is to receive telemetry data from the ATON stratospheric platform in bursts, each 10 seconds, receive images of the terrain each five minutes, keep track of the actual location and to send commands and instructions to the platform, so as to have a better control of the behavior of the platform during flight and if it is necessary, take control of the payloads it is carrying.

This software is intended to be used in the fixed and the mobile ground stations, in order to have redundancy in the ground station subsystem and with that avoid, as possible, the presence of errors or malfunctioning during stratospheric missions.

It can receive by a serial port, at 115200 baud at 433 MHz, the following data:

-Temperature of each portion of the platform and the payload.
-Atmospheric Pressure.
-GPS position.
-At 9600 baud:
-Images of the terrain.

The reception of additional telemetry data fields, such as voltage, current, accelerations and state of the platform is under development and final testing, so as to integrate these parts into the final version of the ground control software.

How it works

The ground control software receives the platform's raw data by two serial points, the first for the telemetry data and the second for the image data.

It separates, filters and processes the data obtained so as to be processed by charts, plots or KML files.

It plots data in separate charts or plots, depending on the obtained data and it saves the time value.

During flight, the telemetry fields, data points and images, which are received, are saved in CSV, KML and BMP files, respectively.

Debugging:

In order to avoid any possible malfunctioning of the software during mission, there are possible issues and problems that have been considered and have been taken in account to do the debugging:

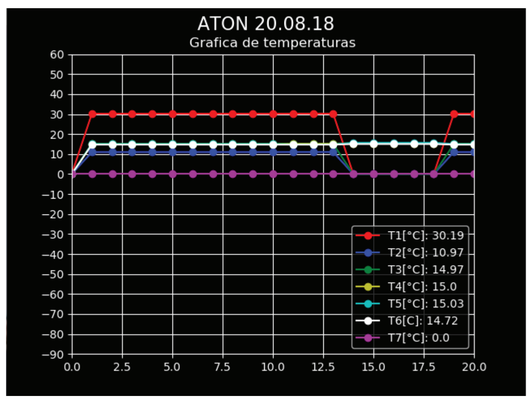
In case the control station receives mistaken data, such as temperatures below -80 °C or above 50 °C, pressure values lower than 0 mbar and GPS latitudes or longitudes below -180° or above 180°; these values will not be considered in the received telemetry data, thus it will not be plot and saved as 0 in the telemetry file. Further analysis will be required to determine the cause of the mistaken values.

If the reception of telemetry stops, this software is capable of pausing itself and not let data to be plot, until communications are reached again, avoiding blank fields in the telemetry file, mistaken maps or images.

Results:

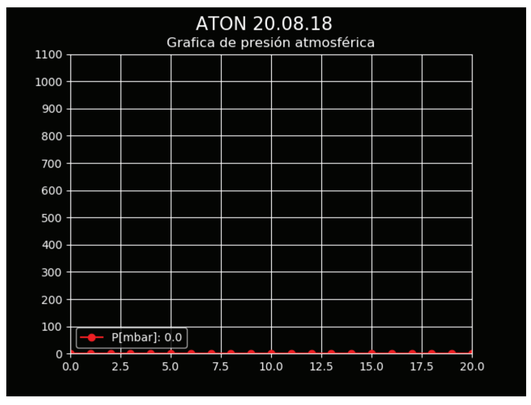
By performing the first tests to this version of the software, along with the ATON stratospheric platform, the following results have been obtained:

Results in temperature:



All the temperature values are put in the same plot, so as to allow an easier and more efficient comparison between the values of temperatures that are being received. It can plot values from -90 to 50 °C. The measurements are plot and saved in [°C].

Results in atmospheric pressure.



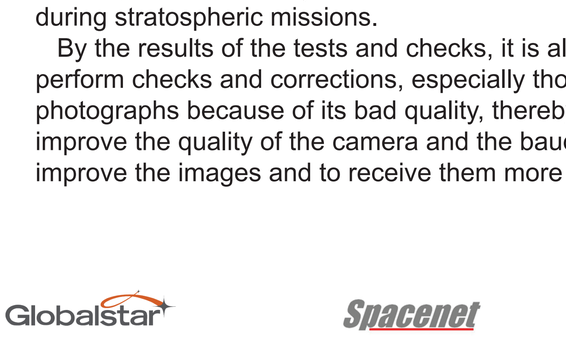
This is an individual plot, it can plot values up to 1100 mbar.
The measurements are plot and saved in [mbar].

Telemetry files obtained.

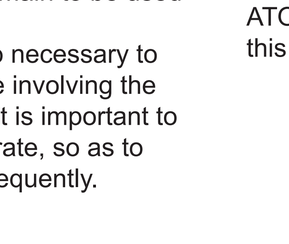
30.19	10.97	15.19	15.28	15.12	14.81	0	0	14:37:08
30.19	10.97	15.19	15.28	15.12	14.81	0	0	14:37:17
30.19	10.97	15.19	15.28	15.12	14.81	35433.56	8490366.4	14:37:19
30.19	10.97	15.19	15.28	15.12	14.81	0	0	14:37:25
30.19	10.97	15.19	15.28	15.12	14.81	0	0	14:37:28
30.19	10.97	15.19	15.28	15.12	14.81	0	0	14:37:31
30.22	10.97	15.12	15.12	14.84	14.81	0	0	14:37:35
30.22	10.97	15.12	15.12	14.84	14.81	0	0	14:37:40
30.22	11	15.06	15.19	14.84	14.72	0	0	14:37:45
30.22	11	15.06	15.19	14.84	14.72	0	0	14:37:49
30.22	11	15.06	15.19	14.84	14.72	0	0	14:37:50
30.19	10.97	14.97	15	15.03	14.72	0	0	14:37:53
30.19	10.97	14.97	15	15.03	14.72	0	0	14:37:58
30.19	10.97	14.97	15	15.03	14.72	0	0	14:37:59
30.19	10.97	15.19	15.28	15.12	14.81	0	0	14:38:02
30.19	10.97	15.19	15.28	15.12	14.81	0	0	14:38:06
30.19	10.97	15.19	15.28	15.12	14.81	0	0	14:38:08
30.19	10.97	15.19	15.28	15.12	14.81	0	0	14:38:10
29.94	10.84	15.25	15.47	15.22	14.84	0	0	14:38:11
29.94	10.84	15.25	15.47	15.22	14.84	0	0	14:38:15
29.94	10.84	15.25	15.47	15.22	14.84	0	0	14:38:17
29.94	10.84	15.25	15.47	15.22	14.84	0	0	14:38:19
29.94	10.84	15.25	15.47	15.22	14.84	0	0	14:38:20

The comma separated value telemetry file includes all data previously plot, it also includes the time of the mission. All the telemetry fields are In order to be analyzed and presented separately.

Tests of the location values



This map, obtained as from the GPS data received is made by creating a KML file with all the telemetry information.
Tests of the images obtained



This window is used as interface to receive images from the ATON platform

Photos received by the Ground control software.

Conclusions

By the development of this software, it has been possible to obtain not only the data that the platform transmits during a mission, also to receive images of the terrain, which is flown above. This is a very important subject, because it will allow to determine the actual behavior of the platform and the payload during the mission.

At first, the use of this software, will be along the first version which is used nowadays, but with the development of the final version, it will eventually substitute it and be the main to be used during stratospheric missions.

By the results of the tests and checks, it is also necessary to perform checks and corrections, especially those involving the photographs because of its bad quality, thereby it is important to improve the quality of the camera and the baud rate, so as to improve the images and to receive them more frequently.

To sum up it is also necessary to integrate the parts of the software that are not fully attached to the already implemented code into a final program, so as to have the final version, implemented for future missions and developments.

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