# ARIES-GPS Payload
# Inter-American University of Puerto Rico Bayamon Campus
# July 2013 monthly report

## I. Activities of the team members

We will describe the activities that the members of the ARIES-GPS Payload are working at this point of the project.

- **Electrical system**
  - After all tests with the prototype board, we started to construct the PCB. The design was carefully revised and done. On the final power board design are the electrical power system, amplifier circuit for the external temperature sensor and the IMU. The design was delivered to a fab house for construction and after the PCB was delivered to us we started to do the standard tests. Finally the PCB was soldered with all of its components and implemented in the payload for tests. As we expected the efficiency of the power raise up and thus the power consumption of the payload drops a little. For security reasons a backup for the power board was made, and if there is any problem with the main board we simply use the backup one. The power board was tested for several hours to see its performance and happily everything works a little bit better than we expected (the current draw dropped from the 0.42A to 0.39A, thanks to some software modifications and efficiency performance on the power board). We also worked with the electrical and data connections to perform the space on the payload. Right now we are on the final integration step, and we hope to have all attached and ready to lunch by the end of the week.

- **Mechanical system**
  - During the month of July 2013, the entire structure of the payload was finished. After all required simulations were performed with success, the entire structure was manufactured taking into consideration weight, price, structural stability, ease of access and troubleshooting, among other things. A base was built to hold the computer on the bottom of the payload, as well as hold 4 threaded rods that carry the various circuit boards. Spacers were used between each one of them to ensure easy installation and removal. The outer shell can also be removed entirely as one piece by removing only 8 small screws, again, for ease of access. In addition each individual face of the payload can be removed to access the specific areas of the payload, so the payload is completely reachable through each of its faces. A base for the GPS antenna was designed and manufactured at a $30^{o}$ incline as required. It can accommodate different types of antennas simply by switching the top plate and it can point to any direction in $90^{o}$ increments to compensate for the direction in which the payload is mounted to the balloon. The weight of the entire payload was also physically measured with all its components. The total mass was of 2.8 kg. The limit required is 3 kg.
- **Thermal subsystem**
  - The thermal analysis was made with three constraints, the power generated is 14W, the ambient temperature has a range of $-60\,℃ ¿ 40\,℃$ and the inside temperature has to have a range from $0\,℃ ¿ 70\,℃$. Taking into consideration those constraints first we did the analysis by assuming conduction heat transfer in the inside and radiation heat transfer to the environment on the outside using the heat generated by the power

(14W). Next we did the analysis by assuming radiation on both steps. We run the simulations in NX Thermal Nastran software the numbers were different, but since the payload is going to be in a vacuum atmosphere the both heat transfer will be by radiation and that simulation gave us reasonable numbers. We did the experiments and the numbers obtain were very different from the simulation, we believe that by putting the capton outside the payload instead of inside the heat transfer effect will be turn into conduction and therefore it won't reflect the heat and it will have a better temperature inside.

- **Software System**
  - During the month all the work has been headed to integrate the whole software in the TS-7260 Flight Computer. Integration code was carefully designed to improve system reliability. First a flag system was created to avoid process re-running states and to control software execution upon signal alarms activated in software . In addition the software was customized to reduce power consumption in almost 1 Watt, this state can be self–controlled and will guarantee system performance. Also telemetry was improved to control the system at almost real time while flight is executed; offering the reset, shutdown and on /off state for desired modules if needed.
  - In addition we manage to create a Watch Dog Timer (WDT) feature into the payload, allowing the systems to reset upon software malfunctions of more than 8 seconds. This features ensures a bigger level of robustness to the payload.
  - We have been able to create a storage system for all the data obtained during flight operation. Data storage will be saved in a 2Gb SD Card and a total of four types of files will created storing the data according to the specific mission objectives. All files would be saved as comma separated values(csv) for further analysis and study.

- **System Engineering**
  - During the month we worked mainly in the documentation for the final Flight Operation Plan (FLOP).Documents created in this stage are fundamental for mission success so a detailed set instructions are provided to allow any user to set up the system. For this team is indispensable that our documents meet the HASP requirements.
  - In addition the team is currently creating the FRR to increase the documentation of the HASP payload for further reference. The FRR will contain every detail of our mission objectives, requirements and final assembly.

**II. Issues Encountered During Payload Design**

- The TS-7260 had installed in its flash memory a minimialistic Linux which eliminate most of the common Linux features, however is a fundamental piece in the low power consumption of the processor.
- One of the RF board on the ASTRA GPS receiver was not PC/104 form factor; so mechanical improvements were made in the stacking board process.

**III. Milestones Achieved**

At the time of the projects this are the milestone that we have achieved.

- **Objectives**
  - Power board for the payload was completed.
  - The ARIES GPS payload preliminary assembly was finished.
  - Payload external structure was finished and it is under HASP regulations.

- Software improvements in the auto-running programs for the Linux environment.
- Power text were successfully accomplished
- Final Structure Weight is under HASP regulations.
- Thermal texts were accomplished using HASP_CFP Manual.
- Payload is ready to flight.

**IV. Current Team Members and Leaders**