Aerospace Engineering Department

High Altitude Student Payload

Star Camera for Photometric Model and Space-Imaging Simulation Software Validation

January 25th, 2013

Monthly Report

Summary of Activity

The Texas A&M Student Team has just been recently notified that we have been selected as a backup payload for HASP, therefore there has been limited activity for this specific project in the reporting period. Not knowing if we were going to be selected or not, we focused our effort in securing the resources for the hardware and the student participation in the LTA team that Dr. Girimaji and Dr. Bruccoleri are building in the TAMU Aerospace department. The LTA team will be responsible to deliver the TAMU HASP Payload. Four team members will receive a stipend and will work 10 to 15 hours/week for the LTA team, while another group of volunteers, also with previous experience with LTA, will provide support.

As for the hardware resources, we already have, at SERC, a payload that was designed and built to perform star light photometry at high altitude for a balloon, and therefore plan to build on that design, making as fewer changes as practicable. In the next few weeks we plan to review the details of our current design, make the necessary changes and procure any part that may need upgrade.

We intend to be able to fly the payload in 2013, but we recognize the difficulty of doing so given the limited time available for system integration.

In the following I have addressed the questions posed in the e-mail debriefing document that we received from HASP.

Debriefing questions

Q: Please provide the following: a complete weight budget, power budget with circuit diagram, dimensioned mechanical drawings, complete thermal plan, uplink and downlink telemetry requirements, analog and discrete requirements, data structure and commanding requirements.

We are reviewing the existing design and making the necessary changes. These technical items will be provided as soon as practicable, before PSIP.

Q: Payload goals are very similar to previous HASP payloads by Colorado. However, there is no discussion as to why their payload would succeed while the Colorado payloads had significant problems obtaining star field images.

We are not aware of the HASP payload by Colorado or the kind of problems that they had with their design, i.e. did they encounter Hardware issues? Software issues? Not enough/too much exposure? Stray light? Defocused images? Moisture in the optics? Attitude rate changes (e.g. rotation) too high? Control of the camera parameters?

SERC researchers and TAMU Aerospace have expertise in designing, testing, and building Star Trackers, thus we have a good understanding of the issues that may result in poor imaging conditions for astronomical images.

Q: Only that this is a new payload, so early integration and testing is crucial.

We certainly agree with this statement.

Q: Claim that a "packet radio" will be used for telemetry and control, but no details are provided. Then claims that HASP serial telemetry will be used. So which is it?

The existing design includes a packet radio, but since some telemetry is available from HASP, we will make every effort to use the existing standard interface on HASP.

Q: No discussion of whether they need night time for their observations. Is there a night flight requirement? This may not be able to be assured.

If the camera is pointed away from the Sun and Earth, nominally more than 30 deg and 45 deg respectively, we expect to be able to take astronomical images at high altitude, away from most of the atmospheric light scattering. If these requirements cannot be met in HASP, then we need to reconsider the feasibility of this payload. A baffle will be mounted on the camera to reduce the impact from stray light. The placement with respect to the balloon itself is also an important consideration for stray light if sun light is reflecting off the balloon.

Q: The payload name is entirely too long.

We will make it a priority to find a suitable acronym.

Q: What is the COHU camera? You mention it but never explain that it is. If it is part of your requirements and objectives, you must explain it.

The co-mounted camera is part of the existing payload design, which had more ambitious goals (Space Situational Awareness). We plan to reduce the complexity and weight of the payload by removing this requirement.

Q: What frequency will you be transmitting? CSBF will have to test and approve all student group payload radios. Why not use the uplink / downlink capability of HASP instead of the radio?

We will use the HASP downlink capability. We won't need to transmit images if the payload, with the data recorder, will be recovered. This should allow us to work well within the downlink/uplink data rates offered by HASP.

Q: The experiment sounds interesting, but I'm wondering whether it can come together enough to be ready and fly 2013. I know nothing more after reading this application than you have a desire to take pictures of stars at 125 kft for future star camera work and calibration and that you want to play with a radio in order to telemeter commands and data.

We recognize that the state of our current payload design is not ideal to ensure a flight in 2013, but we are determined to try and appreciate the opportunity to fly as a backup payload. This opportunity is a strong motivator for the students (and researchers) to pursue this opportunity aggressively.

The educational objective of this payload is to give students hands-on experience in designing and integrating a sensor payload, building on the experience of TAMU/SERC in testing Space Situational Awareness camera systems. Validating our models of the imaging conditions of space, applied to a specific camera, would be an important technical achievement which could lead to funding for more payloads in the future. It also introduces students to the issues of astronomical imaging and sensor systems design.