BEXUS

Experiment Integration Progress Review

1. REVIEW

Flight: BEXUS 28

Experiment: IRISC

Review location: LTU Campus Kiruna / Sweden

Date: 19-20. August 2019.

Review Board Members

1. Stefan Krämer (SSC)
2. Jeroen Vandersteen (ESA) via telecon

Experiment Team Members

Diego Talavera	Anja Möslinger
Kimberly Tuija Steele	Harald Magnusson
William Eriksson	Jon Mihkkal Inga
Niklas Ulfvarson	Eligius Weterings

2. GENERAL COMMENTS

The progress is far behind the program schedule. Much of the hardware was not existing at IPR and many decision to choose critical components have not been taken yet. No drastic progress since CDR visible. The team has lost 2 month during the summer time. It was discussed that the possibility to catch up until EAR requires a strong will and team effort.

During the upcoming visit of Jeroen Vandersteen, the team will provide a deeper insight into the algorithm and control systems. The team is in close contact to Jeroen and receives valuable input in terms of the control system.

2.1. Presentation

- Clear presentation by the team. The mentor Jeroen Vandersteen joined in via telecom for presentation and discussion.

2.2. SED

- No comments.

2.3. Hardware

- Not much hardware existing yet. PCBs are in prototype state and mechanics does not exist at all
- Telescope delivered
- Cameras delivered and working
- Gyro delivered and working
- Encoders working
- PCBs not ordered
- RPI not ordered
- BOSCH Profiles not ordered

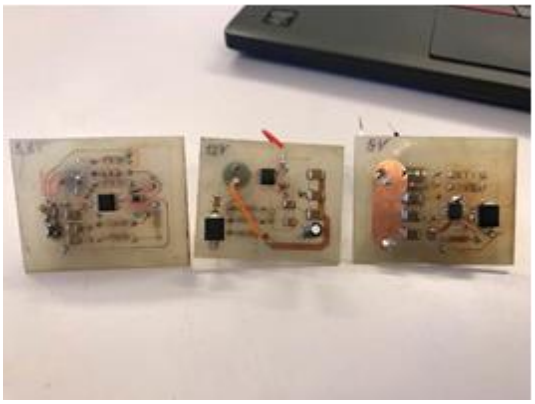
3. FOLLOW UP ON CDR ACTION ITEMS

- The main actions of the CDR have been covered, and most of the recommendations implemented. Nonetheless, the project shows critical delays. In its current status, the experiment design is not developed enough to consider a CDR pass.

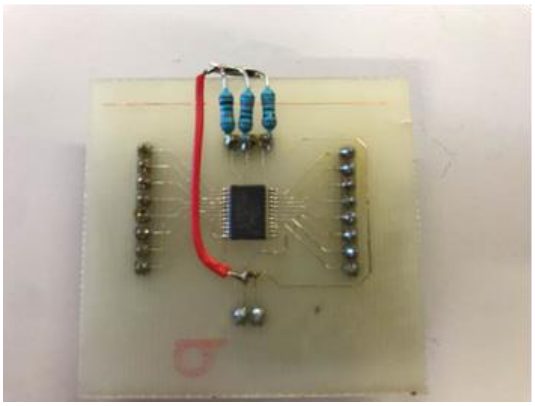
4. PHOTOGRAPHS

Rate Sensor

Telescope with camera interfaced to PC

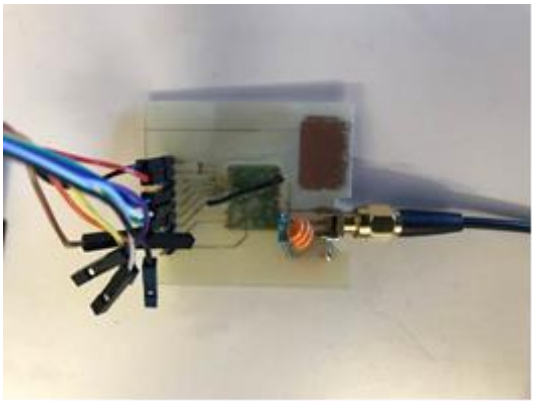


Prototype circuits of power supply



I/O Expander board

Mechanical mounting for telescope



GPS PCB

5. REVIEW BOARD COMMENTS AND RECOMMENDATIONS

5.1. Science

- Algorithm / Control System
  - Target Selection in final testing.
  - Tracking in implementation.
  - PID module in implementation – Tuning of parameters will be done with Jeroen.

5.2. Requirements and constraints (SED chapter 2)

- No comments.

5.3. Mechanics (SED chapter 4.2.1 & 4.4)

- Order the parts you need asap (during the week of IPR).
  - Standard profiles and fasteners.
  - Raw materials for gear boxes.
  - Worm gear components standard parts.
- Manufacturing of the mechanical parts will be time consuming.
  - In house manufacturing on local CNC machine.
  - Accuracy in manufacturing necessary.
  - Tuning of assembly for low friction function of gear.
  - Manufacturing drawings including tolerances not existing:
    - Bearings
    - Shafts
    - Gear
    - Motor / shaft alignments
- Design covers for your encoder and gear sets as well as motors to avoid mechanical damage.
- Use – if necessary – vacuum grease for the gear and bearings. Probably you will not need to lubricate at all. (Braycote 3M / FOMBLIN)
- Chose the Motor ASAP and order it!
- Update the 3D Model on the team site.
- Provide a certain flexibility in the interface to the gondola. Provide long holes in the base plate.

5.4. Electronics and data management (SED chapter 4.2.2, 4.2.3, 4.5 & 4.7)

- PCBs are going to be ordered later this week.
- Do not use the lit for the Amphenol Ethernet connector.
- Consider using energy chain for cable feeding towards the gimbal. It might avoid single cables tangling up and cutting at sharp edges (IGUS).
- Test the heater hysteresis before you apply the heater to your sensitive hardware.
- Test the heater with a heat sink.
- The 5V and 12V DCDC converters have been changes to integrated circuits from TRACO Power.
- Power PCBs for 3.3V, 5V and 12V on prototype status.
- PWM controller for the motor driver unit not yet existing on breadboard.
- IO Expander board prototype.
- GPS board in function.

5.5. Thermal (SED chapter 4.2.4 & 4.6)

- If you test the heaters apply them temporarily to a heat sink.

5.6. Software (SED chapter 4.8)

- It was decided to use the new RPi 4B instead of version 3 due to several reasons
  - More Bus connectors.
  - USB 3.0 which is necessary to drive the cameras at desired speed.
  - Loss of resolution on the cameras on RPi3.
- GPS finished and tested.
- Watchdog functional.
- Encoders finished.
- Camera interface.
- GPS and Encoders on the same bus cause major problem. Team attempts to change to multiple busses instead. (RPI4)
- Star Tracker implementation ongoing.
  - Open source program to be adapted to IRISC needs.
  - Algorithm tested.
  - Test pictures used for test – no HW in the loop.
- Communication
  - Downlink finished.
  - Uplink in implementation.
  - Commands in implementation.

5.7. Verification and testing (SED chapter 5)

- Define a testing schedule.
- No tests so far scheduled and all tests are still pending.

5.8. Safety and risk analysis (SED chapter 3.4)

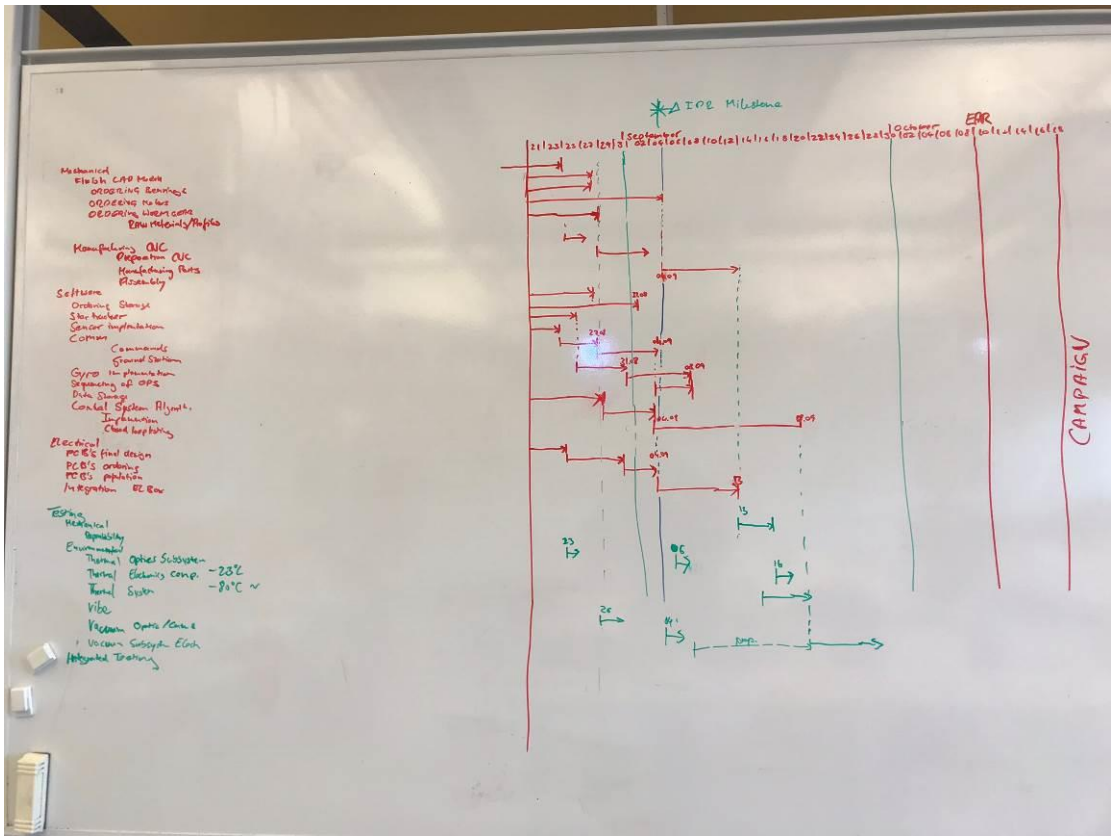
- TC 70 – the result of the FMEA is not clear and hence the risk of single point failures is still existing. Many of your experiment subsystems are mission critical and in case of non-function a mission success is not assured.
- PE 20/30 Re asses the risk regarding staffing of the team, availabilities and the members being not available. Consider Mitigation methods.

5.9. Launch and operations (SED chapter 6)

- Request Late Access in flight requirements for RBF.

5.10. Organisation, project planning & outreach (SED chapters 3.1, 3.2 & 3.3)

- Include the critical path and dependencies into your Gantt chart.
- Introduce mandatory weekly meetings for the whole team. Communication is more than important and lack is clearly one of the reasons for your delay in the project.
- Create a document on the team site which shows the order status and keep it updated.
- Implement weekly meetings.
- Provide proof of the star tracker function.
- Provide the results of the thermal test on the optical subsystem.
- Delta IPR on the 4th of September 2019
- Update the Gantt chart and discuss it in every meeting. Use it as a tool!



5.11. End-to-end Test

- No End to End test performed
  - Single functions proven
    - GPS
    - Encoder
    - Camera
    - Watchdog

6. FINAL REMARKS

6.1. Summary of main actions for the experiment team

- Provide the CAD Model of the final design incl. electronic box and content.
- Provide the final PCB Layout.
- Create a document on the team site which shows the order status and keep it updated.
- Implement weekly meetings.
- Provide proof of the star tracker function.
- Provide the results of the thermal test on the optical subsystem.
- Delta IPR on the 4th of September 2019.

6.2. Summary of main actions for the organisers

- Schedule delta IPR.

6.3. IPR Result: pass / conditional pass / fail

- Conditional Pass.

6.4. Next SEDs version due

- SED v3-2, might be required, TBC.
- SED v4-0, expected for the 4th of October 2019 (TBC).

7. INTEGRATION PROGRESS REVIEW – IPR

Experiment documentation must be submitted at least five working days (the exact date will be announced) before the review (SED version 3). The input for the Campaign / Flight Requirement Plans should be updated if applicable. The IPR will generally take place at the location of the students' university, normally with the visit of one expert.

The experiment should have reached a certain status before performing the IPR:

- The experiment design should be completely frozen
- The majority of the hardware should have been fabricated
- Flight models of any PCB should have been produced or should be in production
- The majority of the software should be functional
- The majority of the verification and testing phase should have been completed

The experiment should be ready for service system simulator testing (requiring experiment hardware, electronics, software and ground segment to be at development level as minimum)

Content of IPR:

- General assessment of experiment status
- Photographic documentation of experiment integration status, with comments were necessary
- Discussion of any open design decisions if applicable
- Discussion of review items still to be closed
- Discussion of potential or newly identified review item discrepancies
- Discussion of components or material still to be ordered or received by the team
- Clarification of any technical queries directed towards the visiting expert
- Communication and functional testing (Service system simulator testing and E-link testing for REXUS and BEXUS respectively)