

902001.99 - 4K ROV Camera Development

Week 51

1. Mark Chaffey
 - a. Cranking out mechanical drawings and submitting to the machine shop.
 - b. Working with Jose on finalizing camera PCB layout.
 - c. DeepSea cutting metal on the camera housing and anticipates continuing progress, they are an exempt business and fully operational in their machine shop.
 - d. Optical adapter metal parts - round 2 - are done and have successfully been anodized. This process failed with the first round of parts after too much material was etched away.
 - e. Final optical assembly and the verification testing of the optical adapter was delayed after the optical house had 7 of 18 employees test positive for Covid. They are back in business but our optical engineer is postponing a visit to supervise the build until the appropriate protocols are in place to ensure his safety.
 - f. All long lead parts are on order or have been received.
 - g. End-to-end testing with the Shipboard video file capture system by Lonny was successful and recorded 4K x 60P progressive video for 24 hours without problems (besides using *beaucoup de* disk space).
Alternate project name: 902001-A *Disk Space Odyssey*.

Week 48

1. Francois Cazenave
 - a. I reviewed the slides from Mark and attended the design review
2. Mark Chaffey
 - a. Held design review with MBARI and DeepSea engineers + scientist.
 - b. Addressing two key items that came out of review 1. Confirming axial compliance matches worst case hydrostatic, thermal and manufacturing tolerance dimensional changes. 2. Re-examining thermal calculations and possible mitigation strategies based on comments (correct) that the thermal margin for 25 Deg. C water was very small.
 - c. Additional factor that is being addressed relates to assembly procedure and if there is enough clearance for tools.
 - d. Camera side PCB is currently in Jose's hands for layout. Here again dimensions are tight and PCB and mechanical design are tightly integrated.

Week 46

1. Mark Chaffey
 - a. Finished with design review materials and scheduled review for Nov. 20.
 - b. Completed final calibration plan for optical alignment.
 - c. Have been submitting parts to shop as drawings are complete and will accelerate this pace.
 - d. Completed the camera controller schematic and have kicked off to layout.
 - e. Made minor modifications to chassis to fit PCB.
 - f. DSP&L partner is now pressure testing a full dome & chassis assembly with shorter barrel. 500+ cycles to date. They perform high cycle tests to look for "nibbling", creep and other subtle pressure effects on the mechanical dome mounting system. All good so far.
 - g. The Adapter optics are in assembly at Myriad Manufacturing with some delay after anodized parts came back with severe etching and pitting. Adapter metal parts are being re-manufactured.

Week 42

1. Andy Hamilton
 - a. Working with Mark on hardware specification for zoom/focus control

Week 41

1. Mark Chaffey
 - a. Final final final decision on penetrations/connectors.
 - b. Slight mechanical design modification for manufacturability.
 - c. Another slight mechanical modification to maintain optical adapter to dome clearance under all conditions.
 - d. Last tweaks to PDR design review materials.
 - e. Working on completing detailed electrical design for μ controller PCB.
 - f. Tested Canon lens servo to confirm the documented command voltage inputs.
 - g. Prepared board materials.

Week 40

1. Mark Chaffey
 - a. Worked up slides for design review. Review is the next big milestone.
 - b. Minor mechanical modifications for simplicity and manufacturing
 - c. Dome design now has 1700 cycles on it at DSP&L.
 - d. Adapter optics glass (5 sets) has shipped. Adapter mechanical parts are in fabrication.
 - e. Revisiting connector specification in coordination with both ROV's.
 - f. Substantial progress on the electrical design.

Week 38

1. Mark Chaffey
 - a. Re-assembled Sony HDC-P50 camera, which was completely in parts for chassis design work. This only took 1.5 hours which proves it is entirely feasible to re-assemble the camera if it is required to be returned for factory service (Sony will no longer perform on-site service).
 - b. Completed final telemetry test. Ran entire configuration over 10.8km of optical fiber verifying ability to transmit Sony RCP protocol as well as chromatic and material dispersion limits for the 12G video link. This is a major milestone and removes the last MBARI technical risk point.
 - c. All mechanical design is complete but drawings need to be done for numerous parts.
 - d. Working on electrical detailed design (system design has been complete for months).
 - e. Completing slide deck for planned comprehensive design review in conjunction with engineering team at Deep Sea Power & Light (DSP&L).
 - f. DSP&L has completed 100 cycles to 4000 meters on the first Dome test article without incident and is now moving to 7000 meter pressure cycling.

Week 35

1. Mark Chaffey
 - a. Added 2x extender actuation to mechanical design.
 - b. Prototyped telemetry system and confirmed that Sony camera control protocol works successfully over 5.4km of fiber. Discovered that vendor had delivered incorrect optical multiplexor part. Replacement due Sept. 10.
 - c. Review preparation.

Week 33

1. Mark Chaffey

- a. Working toward a comprehensive design review in collaboration with DeepSea.
- b. Optical adapter design is now truly complete with new glass specifications (previous glass was not available) and the glass lenses have been quoted.
- c. Optical adapter cell detailed mechanical design is complete with all spacers, etc. and out for fabrication quote from specialty optical assembler.
- d. Chassis design is complete and I have conducted extensive thermal modeling using SolidWorks flow simulation to make sure that the camera system will meet requirements of surface operation in GOC waters. SolidWorks Flow is a powerful tool but as always, requires very careful attention to the inputs.
- e. As noted previously, 20! Domes have been received and test units have successfully passed final polishing, chemical hardening and non-reflective coating.
- f. Life cycle pressure testing of a test dome is about to begin.
- g. With chassis thermal modeling complete, the next major task is end-to-end telemetry verification testing prior to design review.

Week 23

1. Mark Chaffey

- a. Working with DSP&L and the consulting optical engineer on optical path design. Optical design was complete, however the unique glass needed for one of the lenses was unavailable so a minor revision is in the works this week.
- b. During this quarantine period I have been working on the camera chassis design which has proved to be challenging. In order to receive the full benefit of the 4K camera capabilities, the tolerances for the alignment of the camera lens to the optical adapter and the optical adapter to the dome are very tight. This requires providing precision adjustments for lens and optical block position. The design is about 90% complete.
- c. Multiple optical domes are on order and when received will undergo qualification pressure testing with the housing dome support.
- d. Next on the schedule is the electronics and telemetry detailed design.

Week 9

1. Mark Chaffey

- a. Built thermal model in excel that will be used to determine fan and heatsink requirements for chassis and housing. Verified with actual at-sea and design data from i2MAP.
- b. Received Sony camera module and lens.
- c. Loaded in camera 4K license package and color corrected camera output.
- d. Measured camera power dissipation and thermal properties - good news, camera came in at less power than estimated. Makes heat load design easier.
- e. Set-up baseline lens test in building G, will finish this testing Thursday.
- f. Phone conferencing with DSP&L and the optical consulting engineer weekly.

Week 6

1. Mark Chaffey

- a. Much effort coordinating between optical engineer, DSP&L and Canon USA getting additional paraxial parameters to help the optical design work.
- b. Built a detailed solid model of Canon lens from demo unit dimensions.
- c. Optical engineer, DSP&L and MBARI committed to Canon lens and ordered.
- d. Ordered Sony Remote Control Panel (RCP) for camera control.

- e. Completed mature block diagram of the electrical system including telemetry and forwarded to operations for comments.
- f. Started chassis design while waiting for the camera to arrive.