

902204 - Scalable Robotics

Week 29

1. Paul Roberts
 - a. Aug 5 cruise planning and Voyis camera integration
2. Brent Roman
 - a. Developed USB passthru mode to increase framerate
 - b. Working with George Stern to investigate the possibility of running USB between Mola cans to increase available bandwidth for camera.
3. George Stern
 - a. Continued integrating the motor controller and began looking at a permanent deployable architecture
 - b. Ordered parts and made cables for a USB test

Week 28

1. Kent Headley
 - a. Some testing of Cerulean sonar driver, and trying to understand
2. Akshay Hinduja
 - a. Finished degeneracy aware SBN pipeline implementation.
 - b. Empirically found that Portuguese ledge surveys are a poor choice to test SBN, and may never be a good location for it to work at LASS survey altitudes.
 - c. Testing in Sponge Ridge datasets
 - d. Implementing new bounded terrain correlated correction, should help provide a coarse estimate as vehicle moves over larger distances.
3. George Stern
 - a. Finished assembly/installation and testing of a prototype esc controller for mola which translates uart commands into dshot150 pulse streams
 - b. Continued working with Brent on OakD500m improvements

Week 27

1. Kent Headley
 - a. Spent Tue-Wed with Blue Boat, working out the Cerulean sonar device discovery and connection protocols, some of which is undocumented, and the folks at Cerulean wouldn't disclose. Wireshark to the rescue, and kudos to Johann for configuring the Blue Boat to accommodate testing.
2. Akshay Hinduja
 - a. Ran audit on SBN repo to identify overlooked bugs
 - b. Implemented bug fixes on SBN pipeline.

- c. Identify areas of improvement mainly for place recognition
- 3. Brent Roman
 - a. Hacked the camera driver to allow it to pass through JPEG encoded frames from camera
 - b. Increased max frame rate from 6fps to 18fps. Yippee!
 - c. Ripped out Stereo Matcher
 - i. Need to work with Sebastian on optimizing it.
- 4. George Stern
 - a. Finished making up hardware for a mola thruster test
- 5. Johann Voigtlander
 - a. Got the BlueBoat set up so Kent could work on the Cerulean sonar

Week 26

- 1. Kent Headley
 - a. wrote util to convert svlog to LCM and generate MB1 from LCM log
 - b. wrote a little test code to help reverse engineer the Cerulean discovery protocol
 - c. made an initial grid/map of the blue boat survey (20260614) w/o extrinsics
 - i. generated LCM bathy data from svlog
 - ii. merged LCM bathy with nav/attitude log
 - iii. generated MB1 log from combined LCM log
 - iv. used MB-System to generate grid
 - d. Still work to do to incorporate extrinsics and evaluate actual validity/quality of map
- 2. Akshay Hinduja
 - a. Literature review on SOTA place recognition techniques
- 3. George Stern
 - a. Initial preparations for testing new mola thruster hardware/software
 - b. Identified/Ordered new low power SBC (Rock 3C) with NVME interface since the RPi SD card and USB flash hardware is not able to sustain write speeds in Oak500m

Week 25

- 1. Kent Headley
 - a. working on Cerulean BB data
- 2. Akshay Hinduja
 - a. Resume looking at sonar SLAM pipeline improvements
- 3. Brent Roman
 - a. Finally found a thumbdrive that could write raw video fast enough
 - i. But only for 30min at a time. Then, it must be reformatted to avoid "flash folding"
 - b. George and I ordered a Radxa 5C to replace the Pi4
 - i. It supports NVME SSDs

- ii. Found one 2230 SSD that appears to sustain >500MB/s during long writes
 - iii. We shall see 😊
- 4. George Stern
 - a. Looked through many storage options for mola
 - b. Identified alternate SBC which supports NVME and is low power
- 5. Johann Voigtlander
 - a. Wired up and finished VN100 'mini' housing.
 - b. Installed and secured all compas lab equipment on MiniROV
 - c. Tested all compas lab equipment on Mini, completed a wet and dry test

Week 24

- 1. Brent Roman
 - a. Experimenting with SD-cards and Flash drives to store uncompressed video
- 2. George Stern
 - a. Worked with Brent to test OAK-D and raspi image recording bottle neck; hardware alone is a poor fix
- 3. Johann Voigtlander
 - a. Blueboat harbor survey with the Cerulean Sonar
 - b. Set up Conch laptop with blueboat software
 - c. Installed Compas lab equipment on the MiniROV

Week 23

- 1. Kent Headley
 - a. wrote cerulean sonar reader; tested with log files so far.
 - b. working on driver application, logging, publishing, etc.
 - c. Some email exchange with Cerulean tech support, but not finding the responses to be super helpful.
- 2. Paul Roberts
 - a. HSI scoping
 - b. Laser line scoping
- 3. George Stern
 - a. Laid out a small breakout board for mola ESC testing
 - b. Ordered board/hardware and hardware for faster SD card writing test

Week 22

- 1. Kent Headley
 - a. Looking at Cerulean sonar protocols and logging
 - b. Thread re oculus sonar and network traffic
- 2. Akshay Hinduja
 - a. Improvements to registration workflow in SBN

- b. Finished degeneracy aware ICP workflow
 - c. Tested against self with offset, works
 - d. Testing with LASS maps ongoing
- 3. Brent Roman
 - a. Worked with Javiera to determine that Mola is attempting to write video to its RP4's built-in SDcard at >50MBytes/s – suggested architectural changes to make this work.
- 4. George Stern
 - a. Opened and closed mola far too many times to determine boxfish's network topology
 - b. Helped acclimate Brent to mola

Week 21

- 1. Akshay Hinduja
 - a. Test recent changes for eigenvalue analysis supported ICP registration pipeline
 - b. Test point-cloud-accumulator
 - c. Survey state of the art place recognition/point feature descriptors for more robust candidate selection in SBN
- 2. George Stern
 - a. Trouble shot a nonresponsive oakd500m on mola, a broken solder joint on mashed connector in mola was repaired and it is now communicating again
- 3. Johann Voigtlander
 - a. Improved documentation for the blueboat

Week 20

- 1. Kent Headley
 - a. Reviewing
- 2. Akshay Hinduja
 - a. Spring meetings
 - b. Made improvements to mbari_deploy_mbes pipeline mainly to point_cloud_accumulator. Fixes and allows more consistent submap sizing based on spatial distance rather than temporal. Also makes distance between submaps more accurate, leading to 20x space savings from avoiding subamps with 99% overlap being written continuously.
 - c. Found bug in registration transformation composition in mbes_localization. Bug was masked by another bug in DR pertubance modes, and was only caught during last cruise. Took a while to find, but fix is in progress, but will require a lot of tuning later.
- 3. Brent Roman
 - a. Working with series 4 devkit
 - i. Nothing works as described :-(

4. Justin Tucker
 - a. Heading sensor housings being machined

Week 19

1. Akshay Hinduja
 - a. Abstract for OCEANS poster session submitted
 - b. Tweaks and experimental improvements to SBN pipeline
2. George Stern
 - a. Finished updating docs for the now cancelled SuBastian cruise
3. Justin Tucker
 - a. VN100 housing support
4. Johann Voigtlander
 - a. Completed Oceans 2026 blueboat poster abstract "A Compact ASV for High Resolution Bathymetric Mapping in Shallow Water"

Week 18

1. Akshay Hinduja
 - a. Test portuguese ledge data for SBN
 - b. Write abstract for Oceans for SBN, assist abstract for ASV shallow surveys
2. Brent Roman
 - a. Worked with George Stern to determine that camera CPU was overloaded
 - i. By 3 sensors running >12fps
 - b. Added a driver feature decimate frames from a stream
 - i. Sebastian added important logic to it to keep stereo cameras synchronized.
 - c. Recommended testing new generation cameras that offer faster processor and network
3. George Stern
 - a. Final integration, and bench testing of the PoE cans with lights, tank testing - everything appears to work finally but the luxonis hardware just can't keep up
 - b. updated trigger board software to allow triggering stereo cameras at a submultiple of the color camera frame rate to support laser scanning mode. Looks like it works but once again luxonis software needs lots of tweaking to find regions of stability.
 - c. Tested the trigger board at -20C to see if oscillator performance might explain the poor camera/light sync seen on mola at -2C in the Arctic; trigger board output looked good so the problem is possibly in luxonis hardware or temperature was just a coincidence.
4. Johann Voigtlander
 - a. Writing BlueBoat Oceans poster abstract

Week 17

1. Akshay Hinduja
 - a. Test data from LASS cruise with parameter tuning.
 - b. Focus on quality matches rather than quantity
 - c. Look at possibility of very densely packed reference databases
2. George Stern
 - a. Updated spare PoE can and spare OakD1500M with changes
 - b. Primary can spread bench testing and system integration
 - c. Found magic values for strobe light/camera delay
3. Justin Tucker
 - a. Heading housing design, continued

Week 16

1. Kent Headley
 - a. Fixed issue in mbtrnpp that was causing anomalous behavior in mb1stream
 - b. Looks like the pipeline I'd intended to try out this week on the cruise won't work: it's not intended for use with the Reson sonar.
 - c. While testing mb1stream on linux, found potential issue in lcm 1.5.2 cmake (build breaks on find_package(lcm)); filed issue and potential fix with LCM developers.
2. Akshay Hinduja
 - a. Tested data from Portuguese Ledge on SBN, results were iffy, not a good dataset
 - b. Spong Ridge data tests performed well, with complete surveys to test against. Still limited in terms of height variability
 - c. Got successful matches on RC cruise April 14 for a short while before hardware troubles with the Reson
3. George Stern
 - a. Final PoE housing #1 mods completed and initially tested
 - b. Worked with Etechs to begin modifying PoE housing #2 to match 1st
 - c. Identified and worked on a fix for half a ground fault in the PoE can
 - d. Ordered parts and completed chassis wiring for isolation triggering on the 2nd Oak1500M
4. Justin Tucker
 - a. Continued work on VN100 housing

Week 15

1. Kent Headley
 - a. Using MB-System to process Norbit data from the March cruise. Mostly this is an exercise to help develop a tool chain/pipeline that could be used

on the Falkor, and also to become familiar with the MB-System graphical tools

2. Akshay Hinduja
 - a. Test SBN pipeline with Packard cruise data
 - b. Setup Atuncito with pipeline
 - c. Generate new profiles for docker mbari_deploy_mbes
3. Brent Roman
 - a. Finished conversion to DepthAlv3
 - b. Identified that framerate was being limited by network bandwidth
 - c. Revised sen_oakd_lcm_cpp driver to compress images with MJPEG
 - i. Resulting in 3x increase in framerate (from 12 fps to 30 fps)
 - d. Fixed a few long standing bugs in sen_oakd_lcm_cpp
4. George Stern
 - a. Completed PoE can harnessing schematics
 - b. RPi test code, created test harnesses and board checkout of the switch matrix card - working
 - c. Switch matrix card fixturing in PoE can
 - d. Rewired PoE can and oakD 1500m and began system level bench tests - not working, but getting close.
5. Johann Voigtlander
 - a. Forklifted some rowe packs from ESB

Week 14

1. Kent Headley
 - a. fixed a bug in the oculus simulator: message protocol version not initialized before connecting, causing failure to send messages to Oculus Viewpoint and SDK sonar viewer app.
 - b. Ported the SDK sonar app to ubuntu 24; was thinking it might be a good base for an update, but it turns out to be somewhat buggy and lacks a lot of features that are in the Oculus Viewpoint software.
2. Akshay Hinduja
 - a. Test SBN with Sponge Ridge data from Packard Cruise. Works well, even with a small dataset not optimal for SBN purposes.
 - b. Test SBN on Portuguese Ledge data from Packard cruise, need to first prepare reference database tuned to general survey area.
 - c. Setup plan for April Carson cruise for SBN test run
3. Paul Roberts
 - a. Fiber testing, revealed dirty ferrule inside housing, cleaning gained 4 dB
 - b. Optical loss testing, with clean fiber total loss through mux and lancer is < 2 dB
4. George Stern
 - a. Wrote driver to test switchmatrix card and completed card level testing
 - b. Designed fixture for switchmatrix card
 - c. Installed trigger isolation card in OAK1500M (front)

5. Johann Voigtlander
 - a. Removed front and rear cameras from MiniROV for George

Week 13

1. Kent Headley
 - a. Learning mb-system tools (e.g. editing) to understand sonar data pipeline into mapping.
 - b. Profiling two implementations of an LCM log merge tool to compare memory and CPU use
2. Akshay Hinduja
 - a. Test packard cruise data with sonar based navigation stack, figure out which surveys are actually relevant first, and run the system
3. Justin Tucker
 - a. VN100 housing design
4. Johann Voigtlander
 - a. Assisted in Arctic trip packing

Week 12

1. Francois Cazenave
 - a. Designing sebastian plate
2. Kent Headley
 - a. Shore support for Giancarlo's Packard cruise to Sponge Ridge. The weather was often marginal, but they got a lot of work in at alternative sites. My role was to better understand a workflow using MB-System and tools developed by Akshay H and Mauro C to validate and process Norbit multibeam data. I converted data successfully and (less so) attempted to generate grids/maps
The objective is to help develop a complete pipeline for making maps products using data from ScalableRobotics platforms like MiniROV and BlueBoat.
3. Akshay Hinduja
 - a. On shore support to CompasLab team out on packard cruise.
 - b. Wrote pipeline to tie in raw bin files from norbit to a final lcmlog compatible with mbs-tools. Merged these tools into mbs-tools with new pip installable package mb-rawtools to complement mb-convert.
4. Johann Voigtlander
 - a. MiniROV Deployment from David Packard Mar10-17th.
 - b. Demobed from ship
 - c. Mobing at MBARI

Week 11

1. Francois Cazenave
 - a. Subastian sled design
2. Kent Headley
 - a. set up map processing tools for this week's sponge ridge expedition
 - b. providing remote support for Norbit sonar processing
3. Akshay Hinduja
 - a. Support sur ridge cruise from shore
 - b. Wrote log splicing script to merge dive logs missing raw channels with norbit binaries broadcasted to lcm
 - c. Added lcmlogging functionality to sen_norbit as a flag
4. George Stern
 - a. Last week: finished schematics and reviewed Jose's layout for a trigger isolation card for the PoE camera and a switching matrix card for the PoE Can's raspberry pi, ordered some parts
 - b. No ground faults apparent but installed kapton isolation washers in two lights to further increase resistance

Week 10

1. Brent Roman
 - a. Completed port of the driver/daemon from DepthAlv2 to DepthAlv3

Week 9

1. Francois Cazenave
 - a. Helping with change to mapping sled
2. Kent Headley
 - a. Reviewing mbs-tools (sonar log conversion by Mauro C); I may operate/support this on the upcoming Packard Cruise either onboard or remotely.
3. George Stern
 - a. Completed isolation board for OAKD1500M
 - b. Started trigger switching board for PoE can
4. Justin Tucker
 - a. Mini ROV target holders for deployment and recovery

Week 8

1. George Stern
 - a. Began working on fixes for the broken HSI light; need optocouplers with fast edges that won't add to the jitter margin...
2. Johann Voigtlander
 - a. Gave Pushyami and Javiera a tutorial on how to use the Event Camera for their Ventana deployment

- b. Uninstalled equipment from the Ventana sled to be installed on the MiniROV

Week 7

1. George Stern
 - a. HSI lights and POE can rewiring; last minute scrambles to get connectors, rewire housings and get everything tested. Potentially discovered bug in luxonis drivers so the USB version of a card works but the POE version doesn't.
2. Johann Voigtlander
 - a. I created a 2-page manual for the Event Camera, which will be deployed by the Compas lab on Friday on Ventana.

Week 6

1. Akshay Hinduja
 - a. Got localization against MBSysmap maps working (!)
 - b. Good success with 5cm scale maps and 1m scale maps (upscaled using ML sampling methods <https://github.com/Holmes-Alan/PUFM>)
 - c. Implemented NDT matching, global FPFH search to speed up matching performance.
 - d. Implemented standalone localizer, which does not use pose graph optimization
 - e. Added LCM publishing for pose data updates.
 - f. Improved NDT matching voxelization pre process, which gives better results so far.
2. Paul Roberts
 - a. Strobe testing
 - b. DWE camera testing
3. George Stern
 - a. Trigger board calibration procedure
 - b. Tested rolling shutter camera with capacitive discharge strobe light
 - c. Preparations to get triggering working on ventana drawer
 - d. Finished assembling 1 strobe light and ran lumen test with Paul
 - e. Previous weeks - finished ESC controller software and developed preliminary hardware integration test plan but tabled because mola is in high demand.
 - f. Reconfigured 2 of the previously assembled but unboxed HSI light electronic stacks to be strobes (higher lumens LEDs/no lenses) and tested new strobe boards Chris nicely assembled

Week 5

1. Francois Cazenave

- a. meeting
- 2. Kent Headley
 - a. Looking at possible areas of contribution, timing for 2026
- 3. Akshay Hinduja
 - a. Attended meetings
 - b. Have working solution for live $\longleftrightarrow$ live loop closures + reference matching. Need to test out coordinate frame shift for matches, transforms might need a slight tweak.
 - c. Test system with grd conversions to databases for 3cm, 5cm and 1m res
- 4. Eric Martin
 - a. Megatuna bringup
- 5. Brent Roman
 - a. Met with Sebastian Rodriguez to learn project goals/challenges
 - b. Built camera driver on my workstation
 - c. Got the same error messages they get 😞

Week 4

- 1. Francois Cazenave
 - a. Met with Eric to discuss Subastian sled
- 2. Akshay Hinduja
 - a. Found that databases for the submaps store the point cloud in local coordinates, which may create issues when trying to match up against grd file conversions to db
 - b. Looking at sponge ridge data over multiple days to test SBN with.

Week 3

- 1. Francois Cazenave
 - a. Meeting
- 2. Kent Headley
 - a. project kickoff meeting
- 3. Akshay Hinduja
 - a. Continue refinements on loop closure and factor graph implementation for Sonar Based Navigation stack
 - i. Made key fixes and improvements on system.
 - ii. Optimized database look up for reference search, uses 65% less time for the task
 - iii. Unified and tested loop closure and reference matching pipelines to be similar for ease of understanding and changes.
 - iv. Loop closures starting to look better behaved
 - b. Implementation of NDT matching to complement/replace ICP for more robust multi resolution matching
- 4. Paul Roberts
 - a. Planning meeting

5. George Stern
 - a. Completed build of 2 HSI lights, and the remaining 3 electronics stacks
 - b. Swapped and tested the new luxonis camera in the mola docking camera assembly; the old camera threw errors on ROS2 kilted but worked on Jazzy, the new camera throws errors on Jazzy but supposedly works on Kilted; looked like a number of people were begging Luxonis to fix for Jazzy, hopefully they come through
 - c. Continued working on ESC controller software, getting close.
6. Johann Voigtlander
 - a. Cleaned up the lab for the National Geographic tour

Week 2

1. Akshay Hinduja
 - a. Made sweeping changes towards handling constraint addition to graph, unified to be std dev instead mishmash of std dev and covariances.
 - b. Bug fixes and cleanup
 - c. Unified logic for reference match and loop closure match checks to be the same workflow
 - d. Use std dev to weaken or strengthen constraint type.
2. Eric Martin
 - a. Start of year organization
 - b. Team meetings and prep
3. George Stern
 - a. Tested remaining 2 HSI light electronics stacks
 - b. Designed a new baffle for the new camera module which needs to be installed in the Mola Docking Camera
 - c. Identified the problem with the mola ESC controller code: some of the registers advance when read so the debugger was wreaking havoc and the initial problem was merely forgetting what channel coms was attached to.
4. Johann Voigtlander
 - a. Working with Craig from Boxfish to repair Mola 2 batteries