Your Research Logbook

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1 July 2nd to July 7th, 2025

First meeting conducted today, introduced to Biruk and the project. I will be mainly focusing on mount calibration.

1.1 This week's goals

List here your goals for this week (to be done by the start of the week).

1. Read the three papers
   a) ConferencePaper
   b) FYP report - Kaygorodov Egor
   c) FYP report - Hjelmstad Rattigan Mathias
2. Read 10Micron mount manual
3. and the other minutes stuff
4. CICLOPS documentation with mount notes by Dr Amato

1.2 Quick notes and jots

1. Platesolve2 requires: PlateSolve2, APM Star Catalog. Guide.
   Notes
   - APM is installed in `C:\Program Files (x86)\Starry Ridge\APM`
   - Test images can be generated with ESA Gaia Archive as suggested by this post. Go to "Single object" at top left navigation bar, move to a position in the sky and FOV then simply use the camera function.
2. ModelMaker (bottom right of the page) is made by Per Frejvall, same guy who made this youtube video. However, it is old and he died "some years ago". It requires GSC1.1, which is downloded like this:
   - Download wget and put it in `C:\wget`
   - Use this command:
     `wget -r -np -nH --cut-dirs=4 -R "index.html*" -P C:/GSC11 https://cdsarc.u-strasbg`
   - CHATGPT explains the options:
     -r Recursively download all files
     -np No parent — stay within the specified directory
     -nH Don't create a folder for the hostname (cdsarc.u-strasbg.fr)
     –cut-dirs=4 Strip 4 directory levels to flatten the output into C:/GSC11
     -R "index.html*" Skip auto-generated index files
     -P C:/GSC11 Save everything into C:/GSC11

3. ModelCreator is what we will use from now on I believe
4. can book SISO room, flight arena, apparently lending charge of 56 quid?
5. ASCOM Platform 7.0 Not really sure how this works, will have to ask amato.
6. 10Micron forums have been registered, awaiting admin approval. 10Micron Forum
7. SharpCap for interfacing with the camera and mount, and for polar alignment. SharpCap Downloads
8. Risk assessments goes here I think Imperial College Aero Risk Assessments
9. Night at London right now is around 10pm for stars to be visible, good luck... Visible stars are likely Vega, Arcturus, Deneb.
10. Looking from Manual v1 from the documentation folder, focusr motor might need to be calibrated with Celestron PWI Telescope Control Software

1.3 Downloaded software (Only the ones I think I need)

- PlateSolve2
- APM Star Catalog
- ModelCreator
- ASCOM Platform 7.0
- SharpCap
- Celestron PWI Telescope Control Software

1.4 Other downloaded software

- ModelMaker

1.5 Preliminary Knowledge

Just to remind myself, right ascention and declination is measured off the vernal equinox along the equatorial plane in inertial frame. Whereas azimuth is measured as angles from the north point of the horizon clockwise, and elevation is measured from the horizon up to the object in the sky in the position of the observer.

1.6 Literature Review

Just quick notetaking for the papers I read this week.

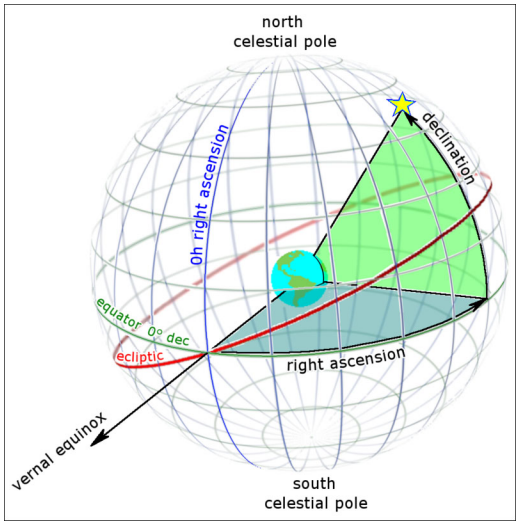

Figure 1.1: Right Ascension and Declination.

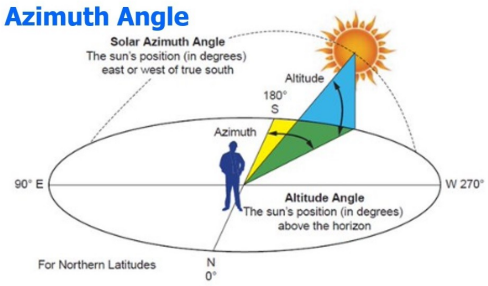

Figure 1.2: Azimuth and Elevation.

1.6.1 Conference Paper

- SSA using 10Micron AZ1000HPS mount with 1 arcsecond accuracy, but without proper calibration it can be 3 deg off.
- Workflow: User > OST > Mount Control > (Mount Control + GPS Tracker + Camera + Astrograph) > Image Processesor > output
- Image Processor: Camera > SharpCAP > Background Removal >
  - Streak identification
  - Platesolve2

  > Data Processesor > Object visual magnitude + object angular parameters
- OST uses ESA's DICOS database with 15000 objects are propagated with SGP4 to find passes using many masks and filters.
- Mount calibration uses 10 star alignment. (Non orthogonal axes cannot be compensated for so must be shimmed if errors are too large)
- Accuracy is expected to be superior to that of "Propagated TLEs"
- Future: Use pyPOGS with mount control, image capture and reduction. (Repo is 3-6 years old...)

1.6.2 FYP Report - Hjelmstad Rattigan Mathias

- Balance reading of less than 0.4% is optimal, done thorugh Menu>Alignment>Balance on keypad.
- TLEs are uploaded to 10Micron
- Most the report is on OST and using it to estimate theoretical errors in tracking by perturbuing orbital elements.
- A lot of SOP is here!

1.6.3 FYP Report - Kaygorodov Egor

- I couldn't really use much of this information, 99% of it is focused on image processing.

1.6.4 Mount Manual

Saftey

- Never look at the sun, never let it ever look in the sun or near it. Do not leave unattended for this reason.
- Make sure mount is stable and locked when mounting astrograph or counterweights.
- Never move "declination axis" from "safety position with counterweights mounted but without telescope mounted on other side" ?? What is declination axis?
- Balancing error can lead to damages
- DO not tighten clutches too much, tracking performance degration
- All connections except LAN must be made before connecting power. As such dont disconnect when power on.
- Prevent tangling cables from rotating parts. Move manually to check
- Clock battery must be 3V Lithium CR2032 non rechargable.
- Do not slew greater than 10deg/s, if needed dont stay near it
- Firmware upgrades might not preserve position memory
- Each second of clock error leads to 15 arcseconds of error in position. Adjusted manually, with PC or GPS module. Clock can be adjusted without aligning again.
- Not advised to change local data settings while object tracking.
- Custom park positions do not have software limits, make sure no collisions can happen.

1.6.5 Youtube video instruction

Talks a lot about the history of the mount, pros and cons of different models. The thing I cared about was the operation of model maker, which apparently is just clicking a bunch of points and letting it do its thing?

2 July 8th to July 13th, 2025

Second meeting with Dr Amato.

2.1 Meeting Minutes

2.1.1 Quick notes

- Dr Amato seemed happy with my progress.
- He will give me access to 227 and update me on the risk assessments, I had to give him my RAFT form.
- Explained how mount models work: Input desired positions then platesolves for actual position. Many points creates a spherical surface of the errors.
- Assembly as soon as possible.
- New project: Programmatic control of the mount. Start by following a predetermined path, closed loop control is the end goal.
- Need to book Blackett roof for observations, but for now use the open area in floor 3 next to his room.
- Model Creator was just not maximised!! I reinstalled ASCOM 7, 6.6, Mount Creator, .NET frameworks and everything, I was so stupid!!

2.2 Quick notes

- PyPOGS might not be usable with 10Micron mount, I will be using ASCOM python interface for now. The ITelescopeV3 interface has all the functions I need.
- Mount Creator is maintained and can be run on command line for automatic control. However, it seems everyone uses Mount Wizzard 4 for mount calbration so I will look into it.
- Dr Amato suggested using the mount without telescope/weight attached, I don't think that is a good idea
- Sent: Is it safe to motorise (skew) the AZ1000HPS ALTAZIMUTH MOUNT axes without putting the telescope and the counterweight on? I want to try testing slewing over the ASCOM protocol with Python safely, without all the heavy weight on the mount, which might cause expensive damage. To their contact page. I also posted the question to the 10Micron forum.
- UPDATE: They replied saying it is safe to do that! Especially for the Alt/Az mounts. Technical support also replied: Dear Mr. Leung, yes, it is safe to slew the mount without any load like telescope, counterweight a.s.o. Best regards Michael Risch.

- MountWizzard4 has video tutorials.
- MountWizzard4 is kind of annoying, for now if I want to run it use run.bat as it requires Python 3.10 and I have 3.11 installed natively.
- Using the ASCOM OMNI-simulator and win32com works, it just simply works.
- Possibly will use ASTAP from now on for plate solving.
- Inputs: Dense path over time of the TLE propagated trajectory
- Outputs: Axis rates and positions / Slewing?
- look at how PyPOGS moves the mount, does it slew or follow rates
- Make sure the control system is documented well
- SATchecker

2.2.1 Notes on ASCOM interface:

- ITelescopeV3 interface has most of what I am going to talk about, but here are a quick few notes:
- SlewToAltAzAsync and SlewToCoordinatesAsync (RA/DEC) for going to a position.
- AltAz must have tracking disabled `mount.Tracking = False` to slew, and for Coordinates it must be enabled `mount.Tracking = True` to slew or else will return an error.
- Non Async versions return after the slew is complete, so pretty useless for path tracking.
- I thought I would be able to use TargetDeclination or TargetRightAscention, which according to the documentation should be updated when SlewToCoordinates(Async) is called, but for the omnisim, not sure if this is true for the real mount the target equals the current position while slewing, so it is useless?
- Slew speed is set by the mount, which for 10Micron can be set in the driver when the driver is initialised. More details on the driver notes fig. 2.2
- The omnisim slewing seems to move in weird directions when slewing? Maybe this will change on the 10micron mounts. I can safely test without the telescope or counterweight attached according to the forums and technical support.
- Will now try to develop a open loop (derivatives of axis rates from any designated path, later on being TLE trajectory) then closed loop to bring it closer using `MoveAxis(0, 1)` and `MoveAxis(1, 1)`, where 0 is primary axis (e.g., Right Ascension or Azimuth), and 1 is secondary axis (e.g., Declination or Altitude) according to the documentation.
- Maybe use `SetPark()` and `Unpark()` when stopped to be safe. Also, use guard statements and logging with all the "Can" commands to check if the mount is ready to move, e.g., `CanMoveAxis(0)` and `CanSlew`. Also, use `IsSlewing` to check if the mount is currently moving.

2.2.2 Notes on driver

- Driver is only available on the forums with a verified account (using the mount serial number).
- Slew settings on drive fig. 2.2 in deg/s, according to Dr Amato max 15deg/s but I read never above 10 on the manual?
- Must select Enable sync fig. 2.3 when using model creator! That is the whole point of model creator!!
- Here are some pictures:

Figure 2.1: Main screen of the 10Micron driver.

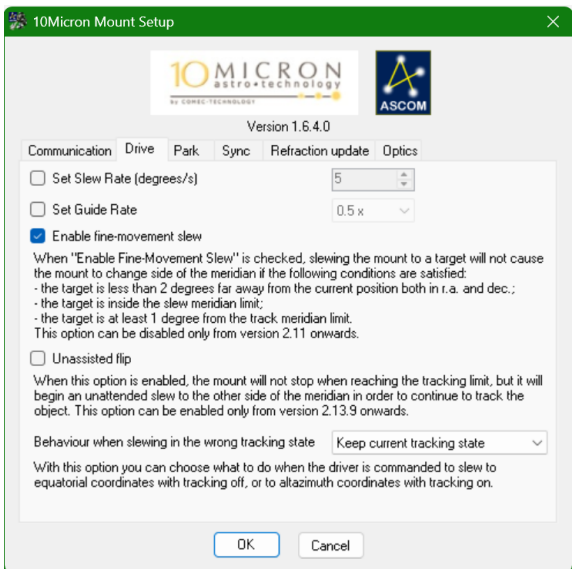

Figure 2.2: Drive settings of the 10Micron driver.

Figure 2.3: Sync settings of the 10Micron driver.

2.2.3 SATchecker

- This is hell. Their setup process doesn't work. I have raised an issue on the github and will try to get it working.
- Here are the steps by steps of how to install it that I know for windows. Modified version of this setup as that doesn't work.:
  1. `git clone https://github.com/iausathub/satchecker.git`
  2. `python3 -m venv venv`
  3. `venv/Scripts/activate`
  4. `cd src/api`
  5. `pip install -r requirements.txt`
  6. Now, the setup says to run the API server but that doesn't work yet.
  7. In `.flaskenv` change `LOCAL_DB=0` to `LOCAL_DB=1`
  8. Install Docker Desktop for your OS: here
  9. Cd in terminal to `dev/local_db`
  10. `docker build -t satchecker-db .`
  11. `docker volume create satchecker_db_vol`
  12. `docker run -d --name satchecker-db -v satchecker_db_vol:/var/lib/postgresql/data -`
  13. Go to `src/api` and run the following commands to retrieve TLEs:
  14. `python retrieve_TLE.py -m gp -s localhost -p 5432 -d postgres -u postgres -pw sat`
  15. `python retrieve_TLE.py -m sup -s localhost -p 5432 -d postgres -u postgres -pw sat`
  16. Download redis from here through the installer
  17. In one terminal instance (I was using powershell) run `$env:PYTHONPATH = "C:\...Yourpath...\s`
  18. Then run `flask run`

- This should put all the TLEs in the database, but the flask server doesnt show any! Apparently all the launch dates and decay dates are required to be in the database, but they don't exist from the TLEs! The github issue might fix that.
- Use pgAdmin to connect to the database and check if the TLEs are there

2.2.4 MountWizzard4

- This seems a bit too complicated to get working, but I had it installed.
- ONLY works on python 3.8-3.10, it can only be ran like that! The only way I got it to install was through this github release page and this youtube video.
- Obviously use python10.exe instead of python for the video.