Quadchart

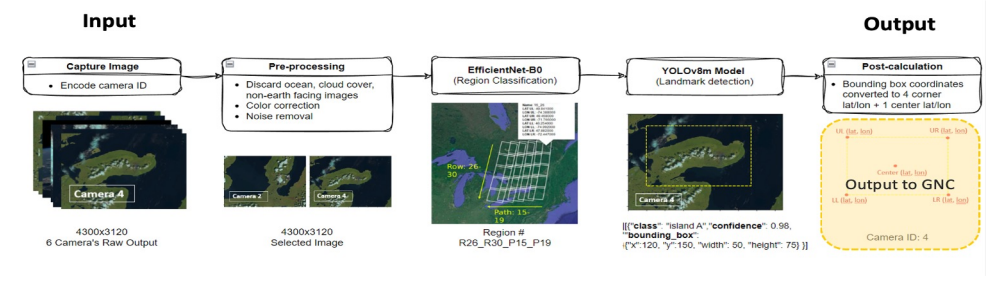
22/01/24

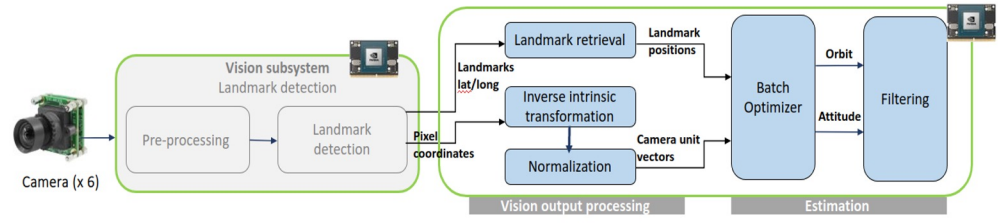
Demonstrating Visual-Inertial A&OD & On-Orbit Edge Computing

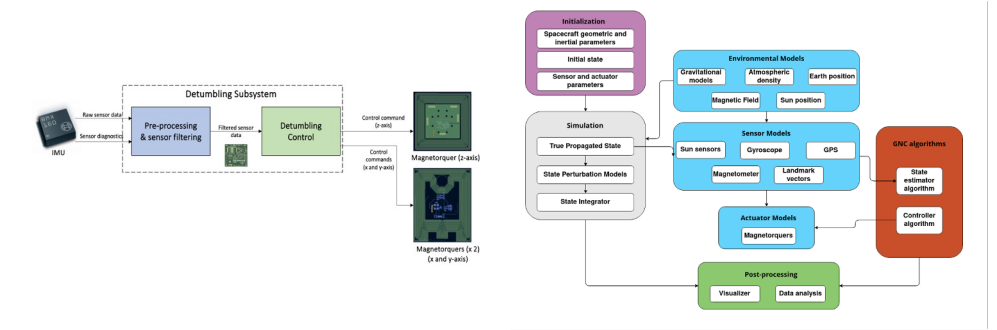
Payload-GNC-FSW - Team merging

- PDR
- Initial work on AD/OD Pipeline
- GNC hardware selection
- Datasets
- Orbit analysis
- Simulator v1
- FSW Functional architecture
- Detumbling control
- Helmholtz Cage Design
    - Cancelled ⇒ Dark room testbed

⇒ Lots of cross-development with Avionics & Comms







100 days before May 1st

Plan for the semester

- Payload-GNC-FSW coupled development
- **Two–week development cycles** with predetermined milestones, plan and deliverables
  - Design iterative prototypes of full pipeline to reach final project completion
  - Each prototype is **fully-functional** and includes development, unit testing and integration testing with hardware
- Why?
  - Quick feedback and learning on the whole development process (both HW and SW)
  - Hands-on approach w/ hardware and boards
  - Consistent validation and metric improvement
  - Motivation

100 days before May 1st

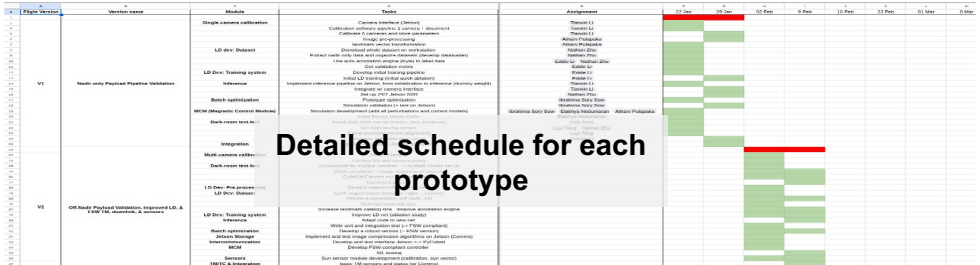
Schedule overview for the semester

Successive development of versioned prototypes (Vn). V1, V2, V3 are fully detailed. V4+ will be expanded as we incorporate feedback. Details on prototype and schedule are here:

- https://docs.google.com/document/d/1MlU3D8B_4Isp-4LFPRzEAeG_gtccRu3iFakApqQPfzs/edit?usp=sharing
- https://docs.google.com/spreadsheets/d/1F0aAKpx0vbFHra7poJnUTnJOS3EivXlNLYzwoGcZlVg/edit?usp=sharing

Flight Version		22 Jan	29 Jan	02 Feb	9 Feb	16 Feb	23 Feb	01 Mar	8 Mar	15 Mar	22 Mar	29 Mar	5 Apr	12 Apr	19 Apr	26 Apr	3 May
V1	Nadir-only Payload Pipeline Validation																
V2	Off-Nadir Payload Validation, Improved LD, & FSW TM, downlink, & sensors																
V3	A&OD updates, early V&V Infrastructure, Power control																
V4	A&OD updates, Autonomy and CD&H dev & testing																
V5	OD dev updates freeze, Autonomy and CD&H, Distributed CD&H, (over-the-air) OTA updates																
V6	FSW A&O freeze, V&V, CD&H, Satellite characterization, Failure Management																
V7	Final satellite assembly, FSW integration, and testing, documentation + buffer																
V8	Final satellite assembly, FSW integration, and testing, documentation + buffer																

Schedule for all prototypes

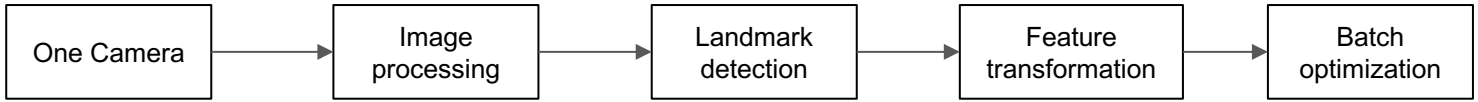


Detailed schedule for each prototype

100 days before May 1st

V1: Nadir-only Payload Validation

- Validation of A&OD pipeline in **dark-room testbed** with **a single-calibrated camera** on **Jetson**.
- Camera captures an image from a well-positioned screen, which is pre-processed and LD net is applied. Necessary transformations then batch optimization to determine attitude and orbit.
- **Simulation of a LandSat pass and report average accuracies**



- Determine landmark catalog size
- Obtain average number of landmarks per images (number of features)
- Define validation metric for landmark detection net
- Determine attitude and orbit estimation accuracy
- Build dark-room testbed in the lab, implement on testbed and find error margins
- Run MCM simulation and analyse performance

100 days before May 1st

V1: Nadir-only Payload Validation ⇒ Feb 2

Module	Tasks	Assignment
Single-camera calibration	Camera interface (Jetson)	Tianxin Li
	Calibration software pipeline 1 camera + document	Tianxin Li
	Calibrate 6 cameras and store parameters	Tianxin Li
	Image pre-processing	Atharv Pulapaka
	landmark vector transformation	Atharv Pulapaka
LD dev: Dataset	Donwload whole dataset on workstation	Nathan Zhu
	Extract nadir-only data and organize datasets (develop dataloader)	Nathan Zhu
	Use auto-annotation engine (Kyle) to label data	Eddie Li Nathan Zhu
	Get validation metric	Eddie Li
LD Dev: Training system	Develop initial training pipeline	Eddie Li
	Initial LD training (initial quick ablation)	Eddie Li
Inference	Implement inference pipeline on Jetson, from initialization to inference (dummy weight)	Tianxin Li
	Integrate w/ camera interface	Tianxin Li
	Set-up 24/7 Jetson SSH	Nathan Zhu
Batch optimization	Prototype optimization	Ibrahima Sory Sow
	Simulation validation (+ test on Jetson)	Ibrahima Sory Sow
MCM (Magnetic Control Module)	Simulation development (add all perturbations and current models)	Ibrahima Sory Sow Elakhya Nedumaran Atharv Pulapaka
	Initial Bcross Monte-Carlo	Elakhya Nedumaran
Dark-room test-bed	Install dark room set-up (covers, tent, whatever)	Luyi Tang
	Get high-res big screen	Luyi Tang Nathan Zhu
	Camera/satellite mount (alignment)	Luyi Tang
	Integrate with calibration set-up	Tianxin Li
Integration	Pipeline integration (Jetson) and testing	