FUSION FLIGHT: UNLOCKING HIGH-SPEED GPS ERROR CORRECTIONS FOR UAVS USING AI

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AUTONOMY, ROBOTICS, & CONNECTIVITY

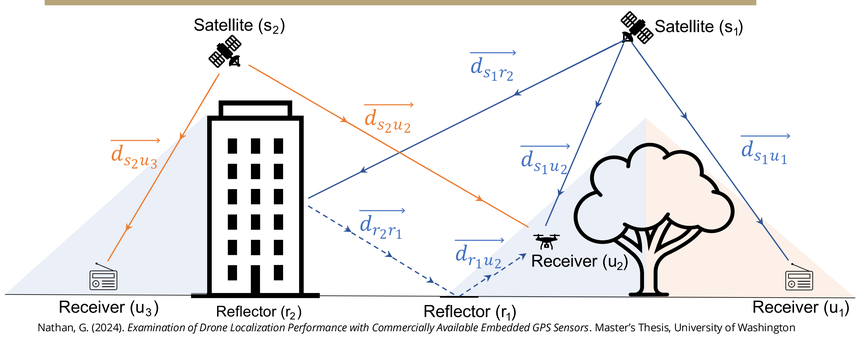
PROBLEM STATEMENT

In order to achieve effective drone operations**, precise and reliable autonomy** is paramount [1]. The autonomy of UAVs depend on proper localization, which currently lacks an effective solution [2]. Our project, **FusionFlight,** tackles this problem with commercially available low-cost GPS sensors, combined with hybrid ML network.

	Status quo		System Performance Target
Weight	20 – 100 lbs.	→	<5 lbs
Cost	$10K – $100K	→	<$5K
Power Consumption	200 - 1500 W	→	<25W
Real-Time Precision	Not Guaranteed Performance	→	Real-Time at 10 Hz

[1] Reid TG, Neish A (2023) Localization & mapping requirements for level 2+ autonomous vehicles. pp 107–123
[2] Gao Y, Liu F, Long T (2013) Analysis of multipath parameter estimation accuracy in MEDLL algorithm. Springer, pp 597–606

MULTIPATH ERRORS



Nathan, G. (2024). *Examination of Drone Localization Performance with Commercially Available Embedded GPS Sensors*. Master's Thesis, University of Washington

OUR APPROACH

We address the problem of multipath with a sensor-fusion technique where we utilize multiple GPS sensors and one of our two machine learning to **predict** and **correct** the multipath error seen above

Sapphire:
- Only utilizes GPS sensors
- <5W power requirement
- 10Hz
- 17.5x increase in accuracy performance
- Real time

Oracle
- Utilizes GPS sensors and an IMU
- Better accuracy with greater power requirement
- >10 Hz
- ~20x increase in accuracy* performance
- Real time

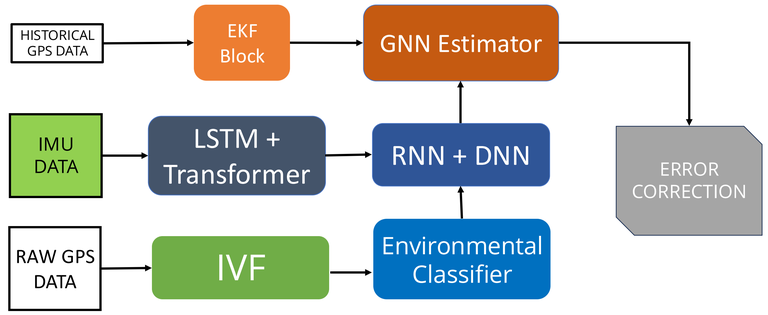
*20x is an approximation, exact statistic requires more testing

DATA COLLECTION SYSTEM DATABASE

Multi-modal experiment data automatically processed into database

Private repository for potential research and commercial **collaboration**

ORACLE MODEL

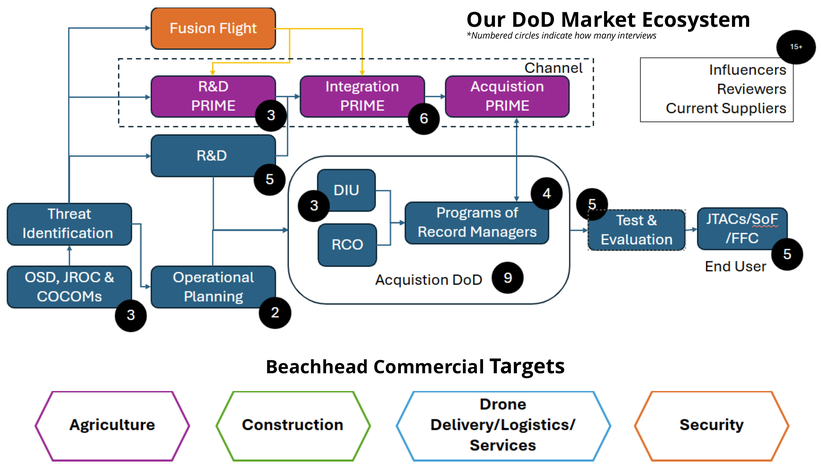


ERROR METRICS FOR SAPPHIRE MODEL

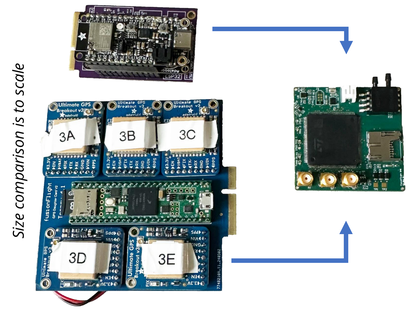
METRIC	Residual Magnitude Error	Altitude Error
PRE-MODEL MEAN	29.96 m	60.00 m
PRE-MODEL RMSE	34.72 m	60.00 m
POST-MODEL MEAN	1.71 m	0.21 m
POST-MODEL RMSE	1.81 m	1.46 m

COMMERCIALIZATION STRATEGY

Throughout our NSF I-Corps, we discovered the need for a "**dual-use**" business strategy. When targeting the **DoD** as a potential user of our technology, it is highly important to prove its capabilities on the **commercial market** in parallel

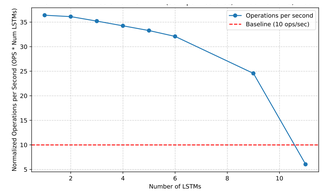


HARDWARE & SOFTWARE OPTIMIZATION



SCOUT
Next Hardware Generation:
- Combined IMU & GPS stack
- Significant size reduction from 15x9x 6.5 cm to 5x5x3 cm
- Significant weight reduction (90+%)
- Power requirement of <5W

SAPHHIRE V2
Model Optimization:
- <10 KB model (90% reduction in dram footprint)
- No significant loss in operations per seconds
- Reduced energy footprint
- Comparable accuracy



FURTHER COMMERCIALIZATION PLANS

Our Startup

GUIDE AIR LABS

NSF Partnerships for Innovation (PFI)

Seeking non-dilutive funding

Expanding SBIR/STTR efforts

SBIR STTR — Department of the Navy — Small Business Innovation Research

FUTURE WORK

- **Dynamic flightpaths** in challenging environments is still an issue. Our next study directly address this. **Dynamic testing will be conducted** to verify ORACLE model's accuracy on GPS data
- Our SCOUT hardware is currently being deployed to **multiple aerial platforms**
- ORACLE model continues to be developed and refined for **dynamic flight conditions**
- Our other project, **Project ION**, will deal with **Ionospheric disturbance** to reduce errors in GPS data.

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