Performance Modeling and Improvements on the GRB Source Localization Streaming Pipeline Aboard the ADAPT

*Where the **Bursts** Come From*

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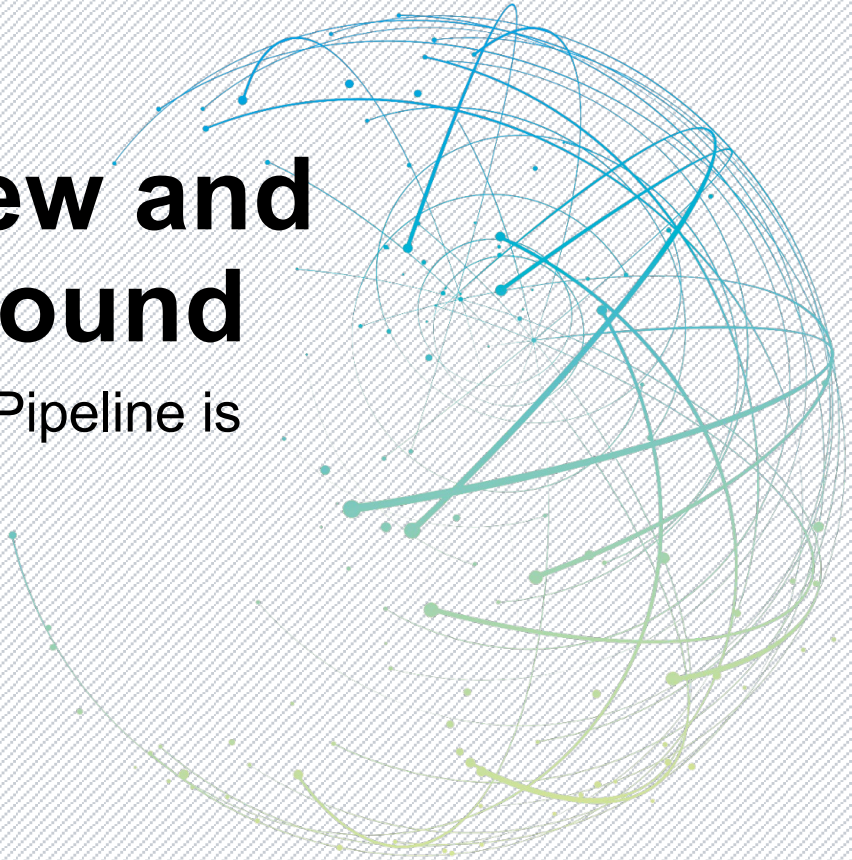
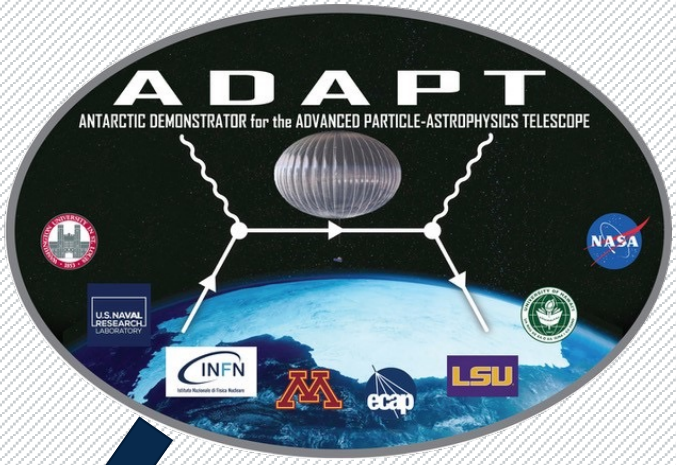
/01 Overview and Background

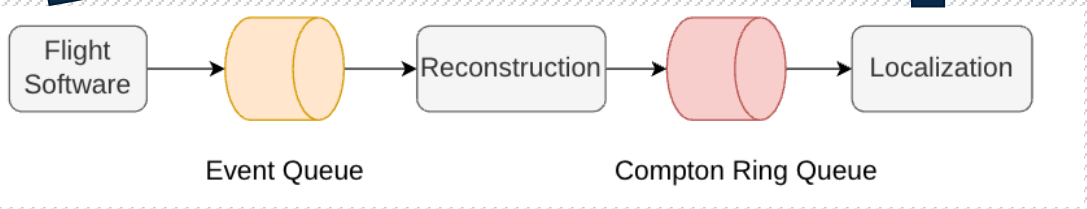
What Stream Pipeline is

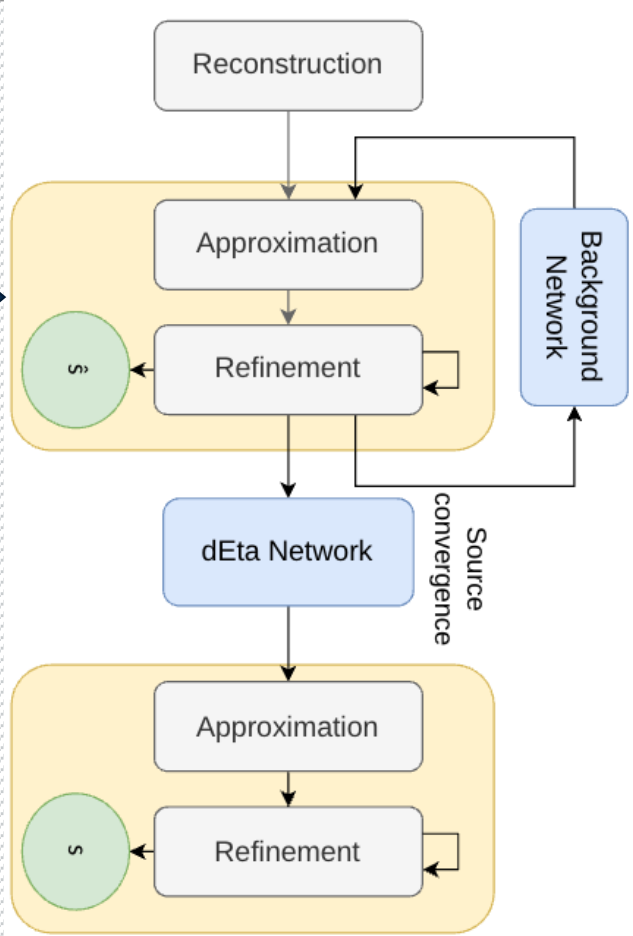
How it Works



ADAPT & Pipeline Flow







/02 Working Summary

What did I do

Performance Modeling

$$n_{loc} = \left\lfloor \frac{1 - t_{rec}(n,E)}{t_{loc}(m,R)} \right\rfloor$$

$$w_{min} = \frac{1}{n_{loc}}$$

- n_{loc} computes maximum number of localizations possible during a GRB of length T
- w_{min} is minimum possible time interval between alerts
- $t_{rec}(n, E)$ is execution time of reconstruction kernel on E Gamma-ray events using n cores
- $t_{loc}(m, R)$ is execution time of localization kernel on R Compton rings using m cores

Timing Mechanism

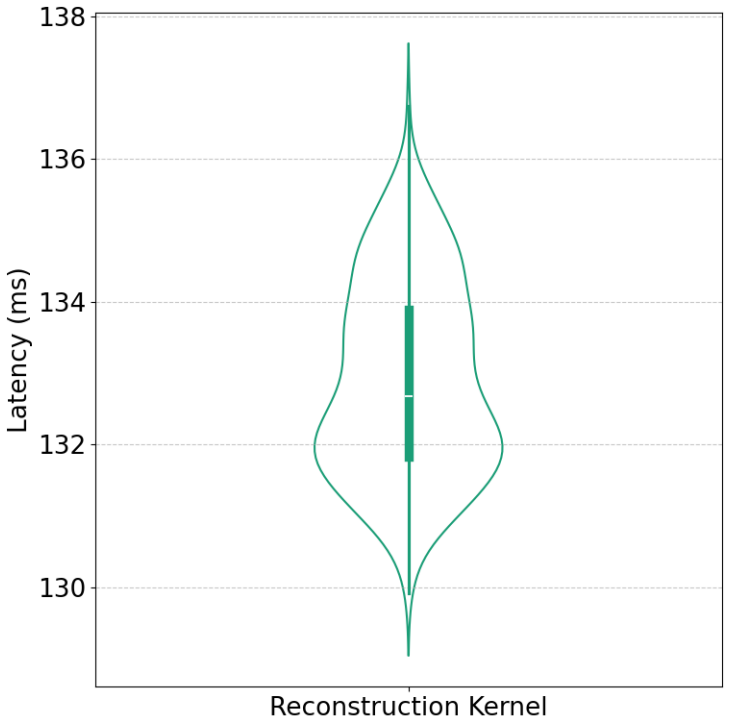
Google --A standardized timing benchmark

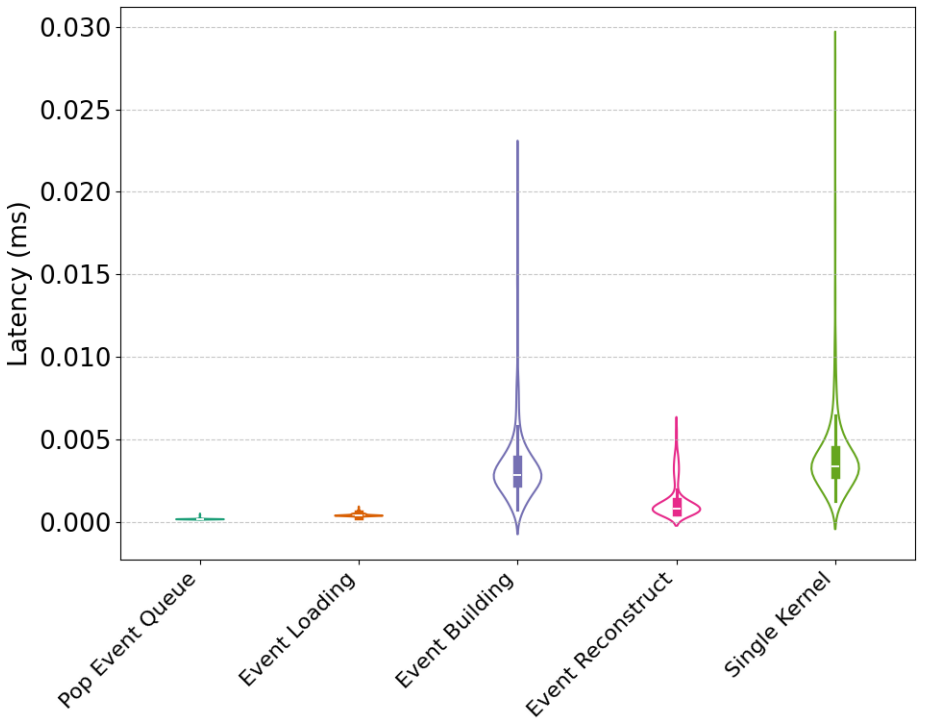
--An easy-to-use timing library

Unordered Map
vs. **Vector**
vs. **Array**

--A manual Stopwatch

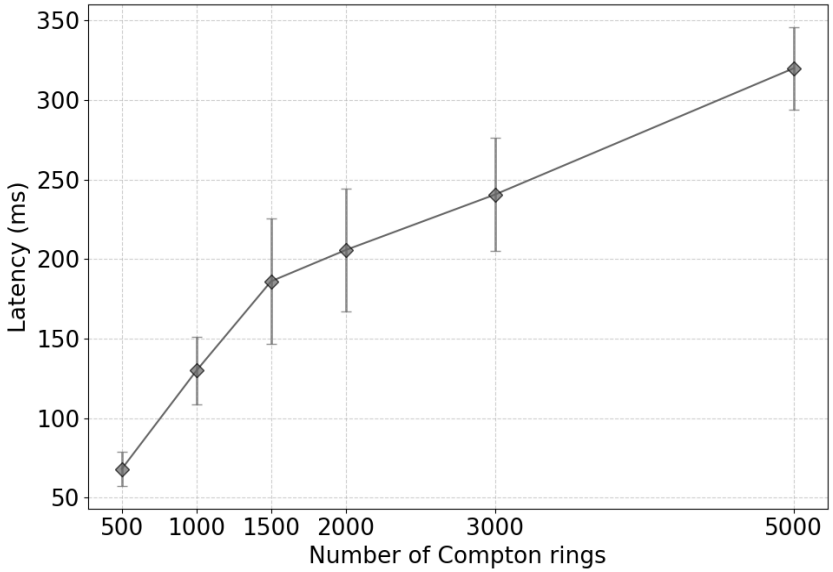
Timing Result: Reconstruction

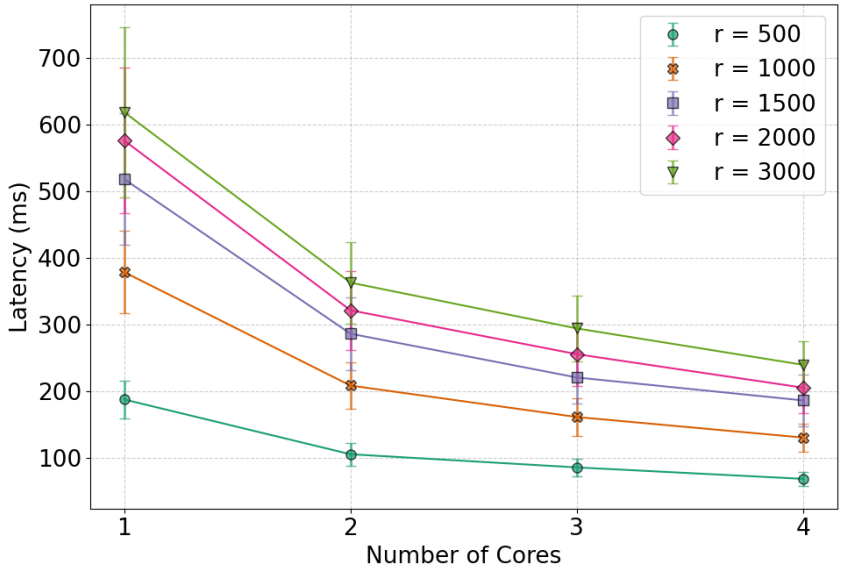




- $t_{rec}\ (n = 1, E = 31{,}746) < 140\ ms$
- clock_gettime(CLOCK_MONOTONIC)

Timing Result: Localization

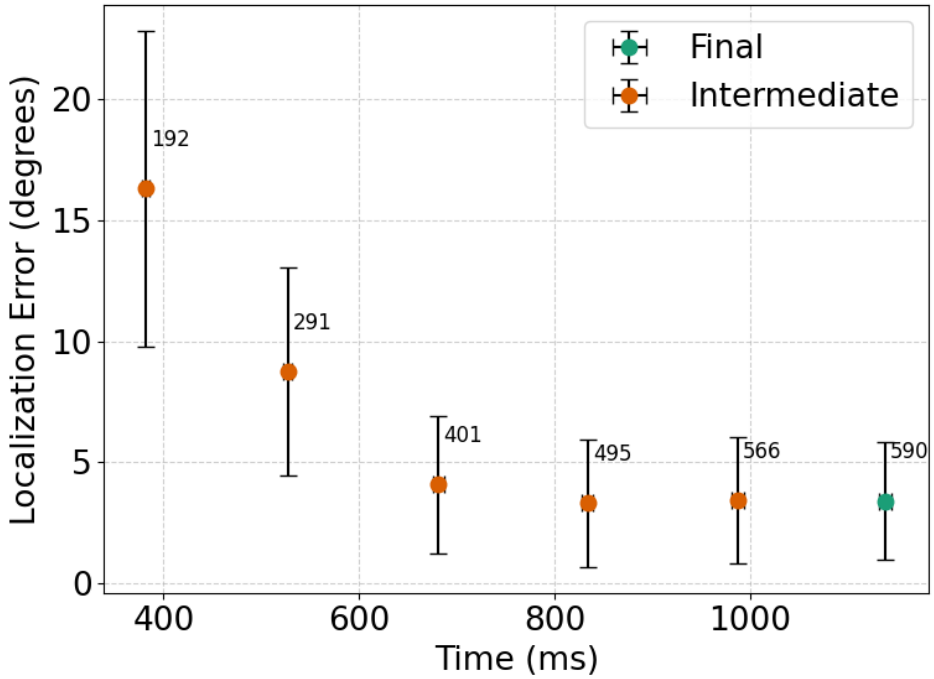




- $t_{loc}\ (m = 4, R = 582) < 100\ ms$
- Slower increasing rate with more rings

- $t_{loc}\ (m, R\ \in \{500, 3000\})$
- Better performance under more threads

Timing Result: Stream Pipeline



$$n_{loc} = \left\lfloor \frac{1 - 0.14}{0.1} \right\rfloor = 8\ batches$$

$$w_{min} = \frac{1}{8} = 0.125s = 125\ ms$$

(set to 150 ms)

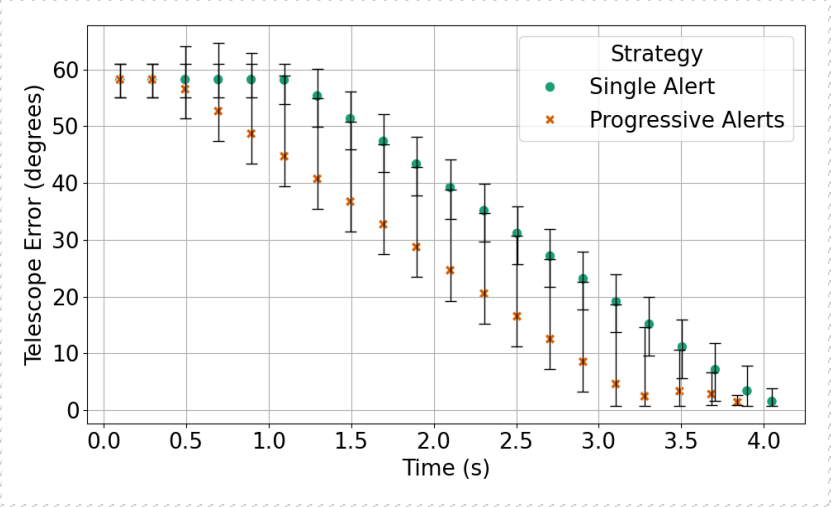
/03 Conclusion and Future Work

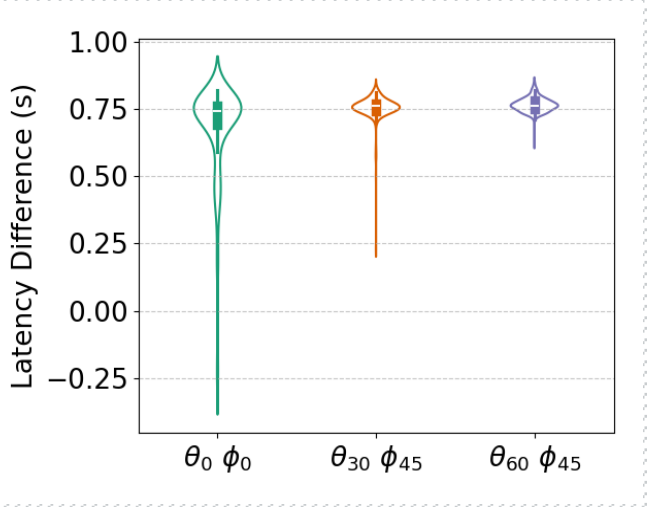
Why this is important

What is for the future

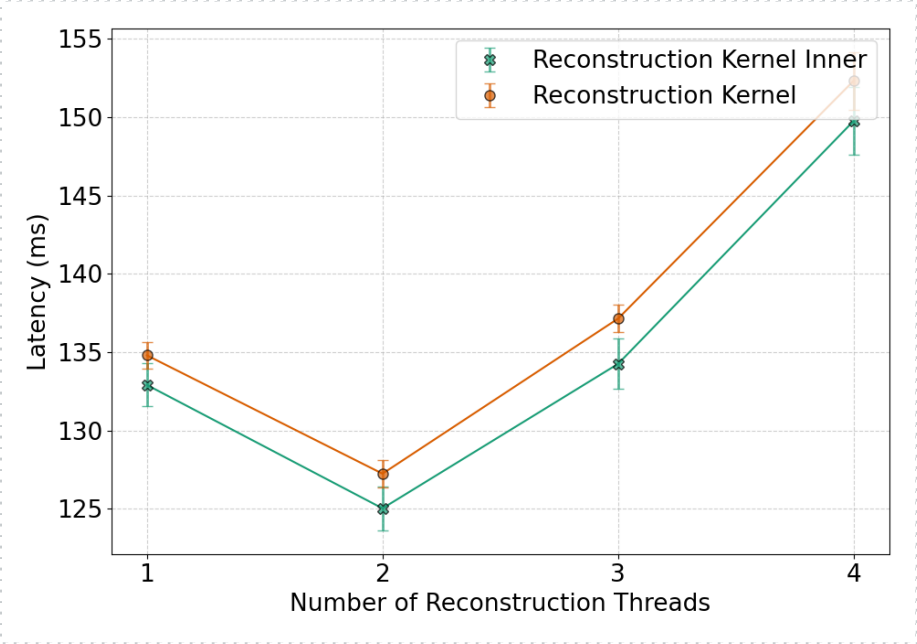
Conclusion:

- Almost free gain of intermediate results, beneficial for real-time alert on partner telescopes
- Telescope simulation with 20°/sec slew rate suggests about 0.75 s earlier on-target time using progressive alerts compared to a single alert





Future Work: Multithreading of Reconstruction



- For each single stage in reconstruction, the latencies are stable for different numbers of threads
- We expect better performance overall using more threads for reconstruction

Future Work: Batch Processing of Pipeline

- How large is the batch size
- What will be beneficial from the batch process

Question & Discussion

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