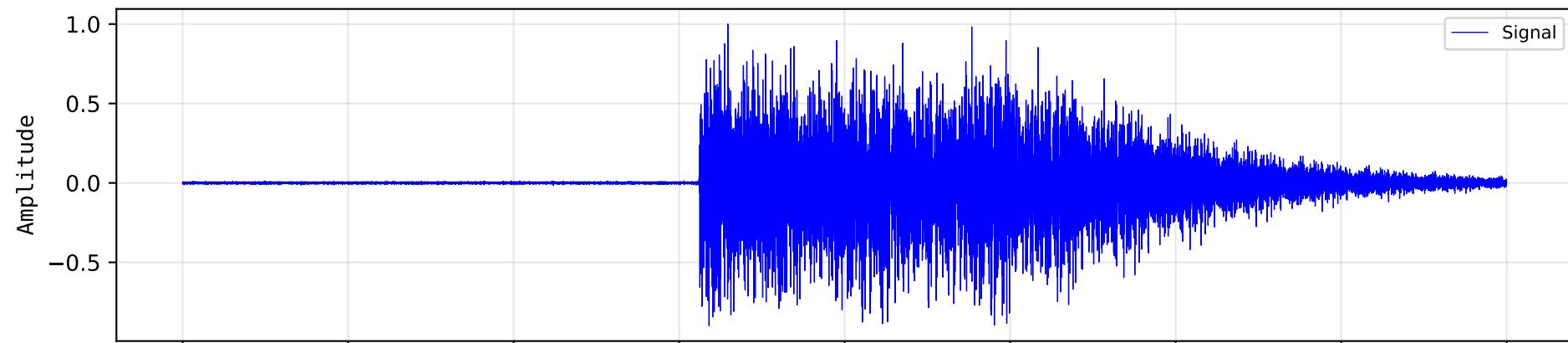


# Part 1: Gunshot Detection (energy + GusUM, per-event chunk extraction)

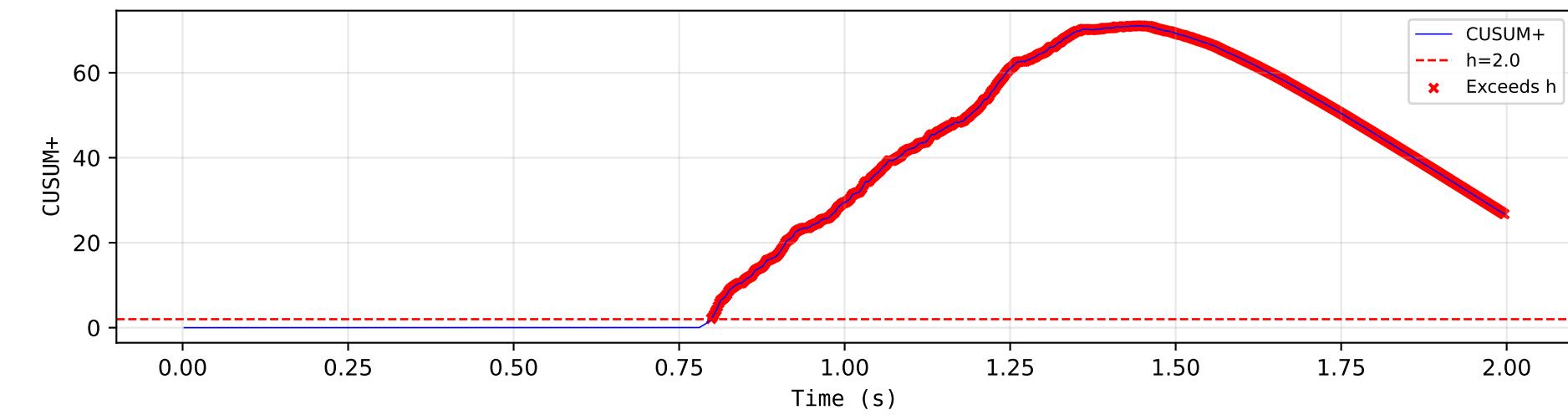
Channel 1 - Waveform



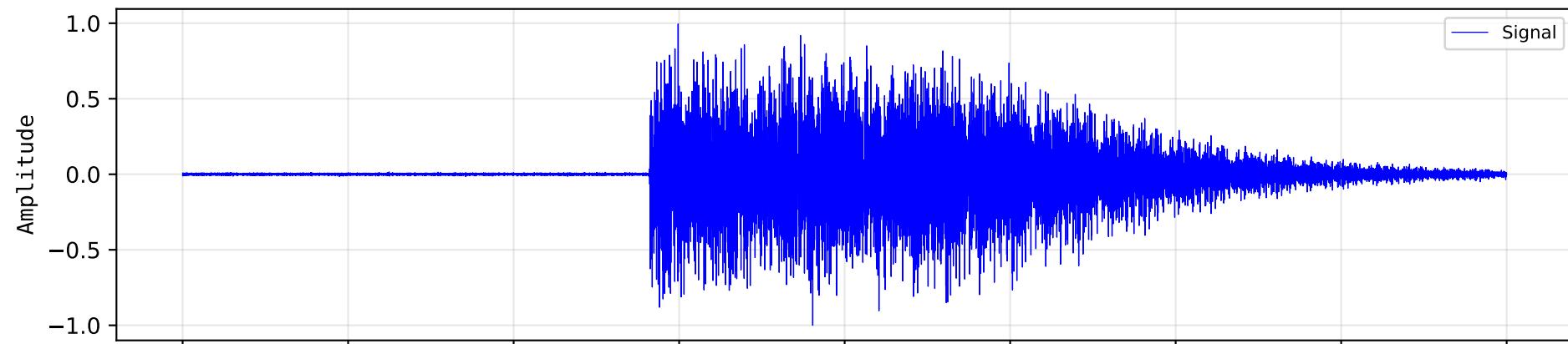
Short-Time Energy



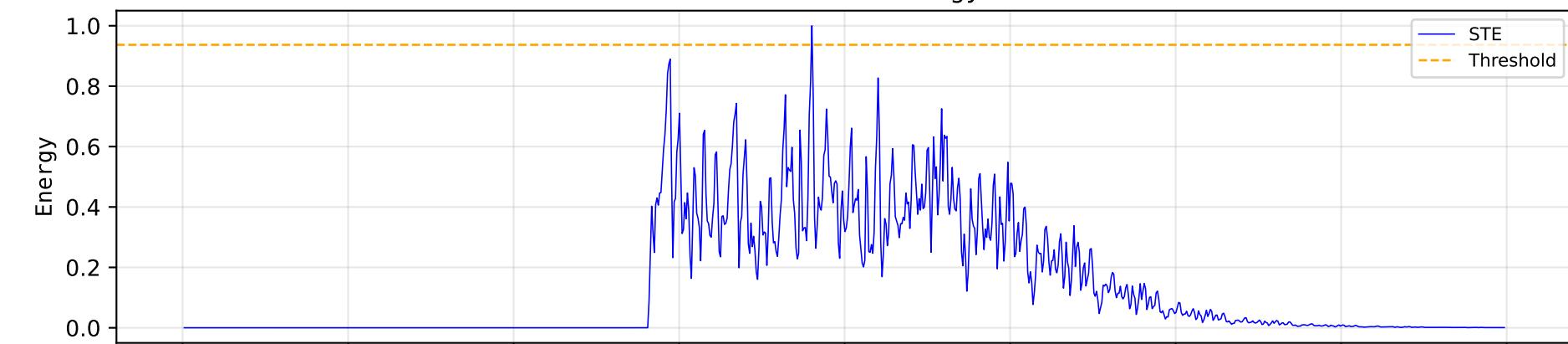
CUSUM Curve



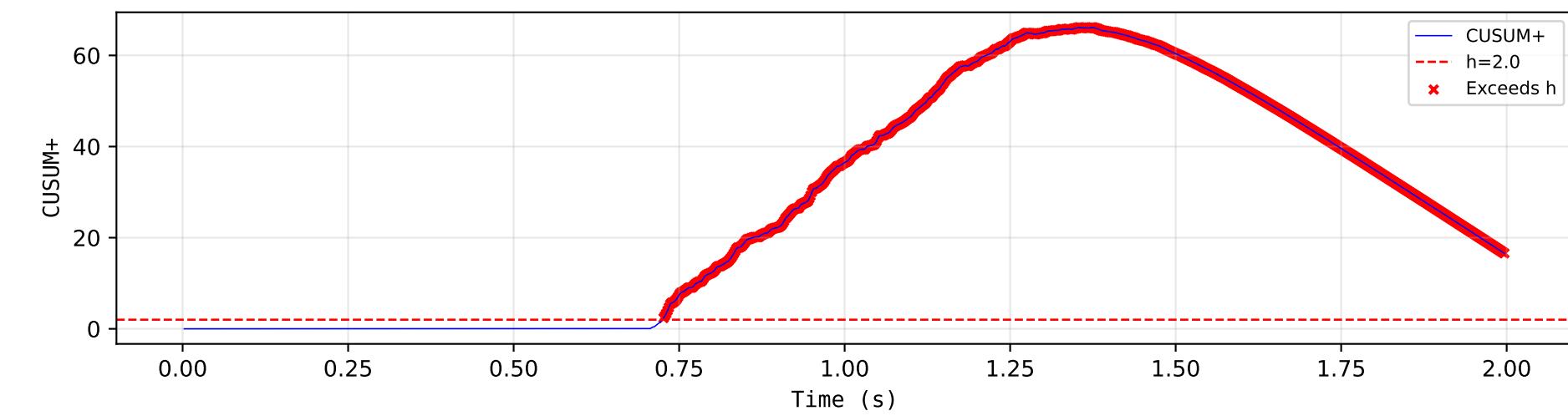
Channel 2 - Waveform



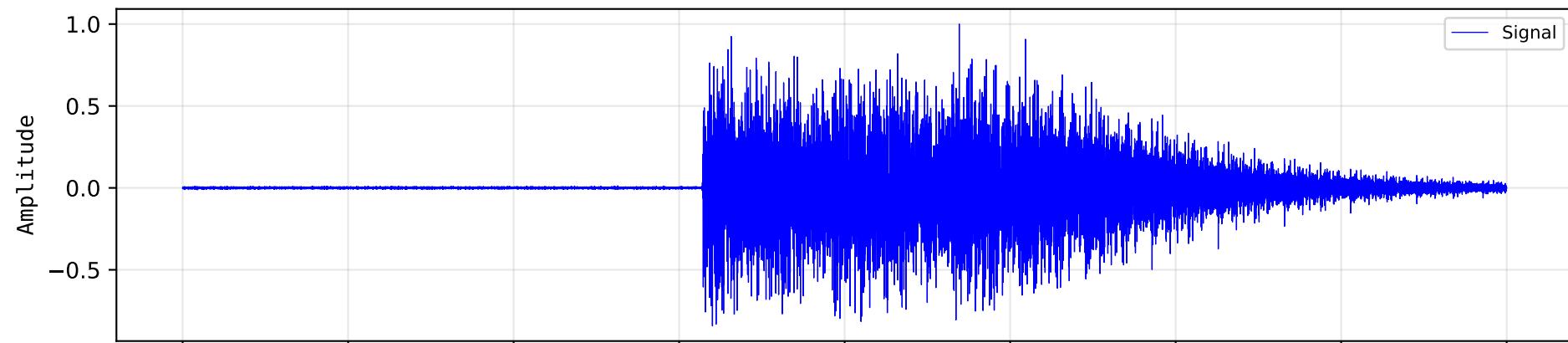
Short-Time Energy



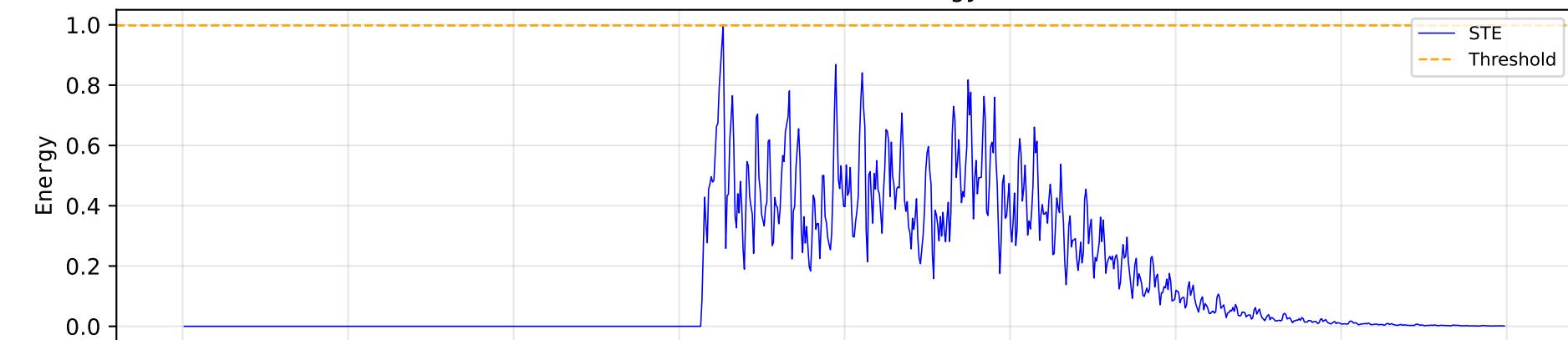
CUSUM Curve



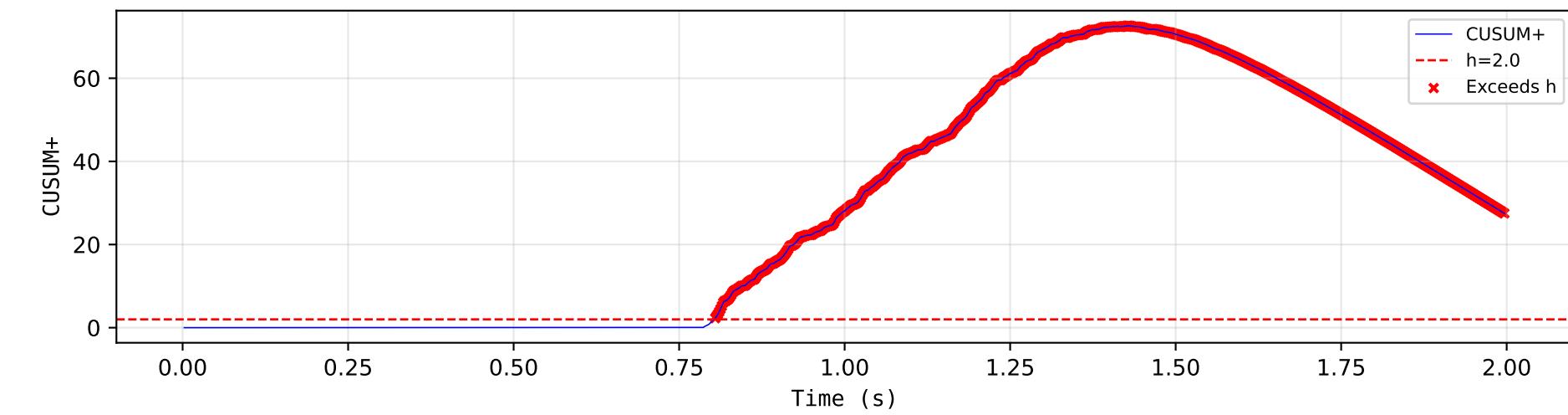
Channel 3 - Waveform



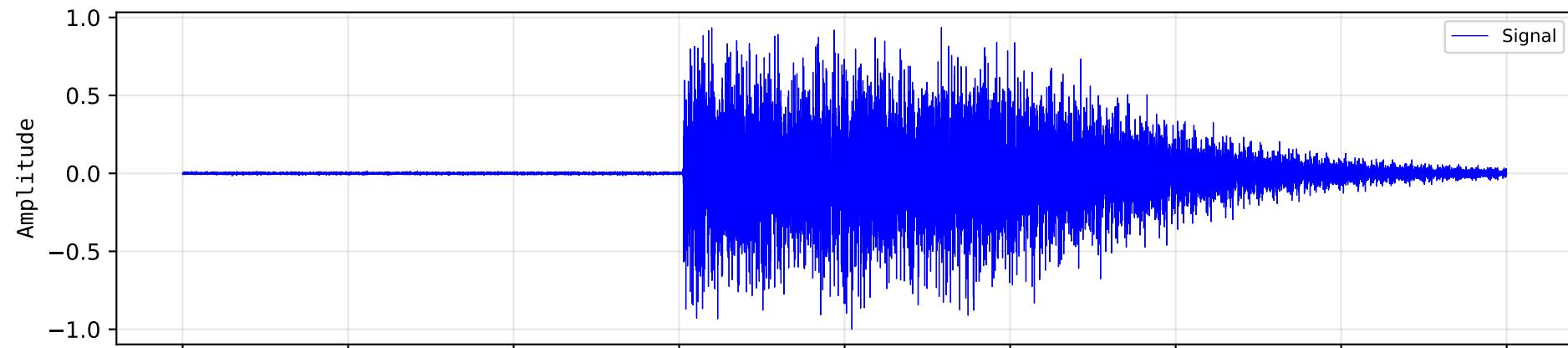
Short-Time Energy



CUSUM Curve



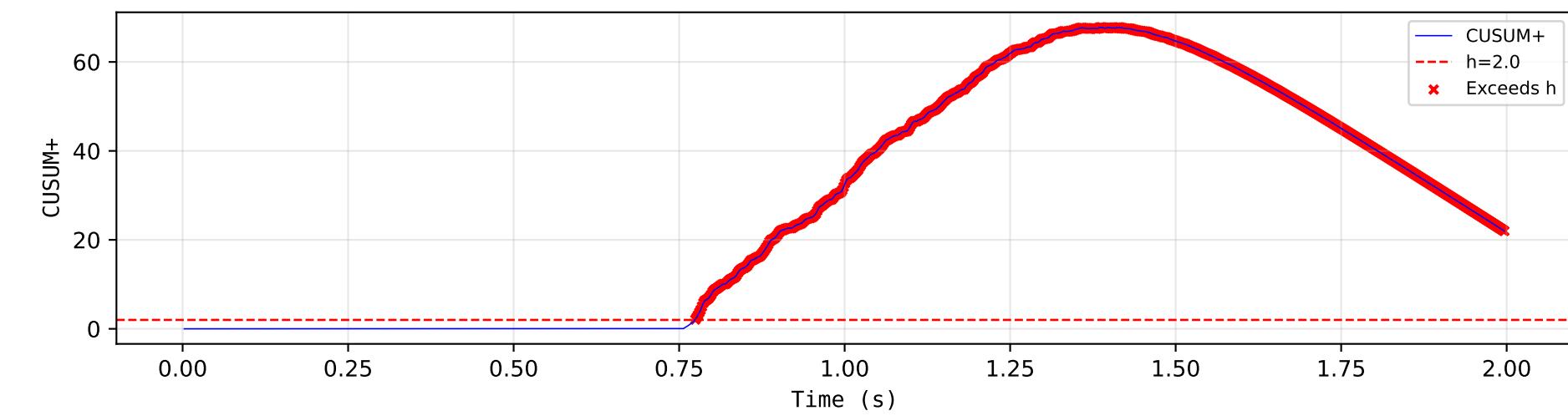
### Channel 4 - Waveform



### Short-Time Energy



### CUSUM Curve

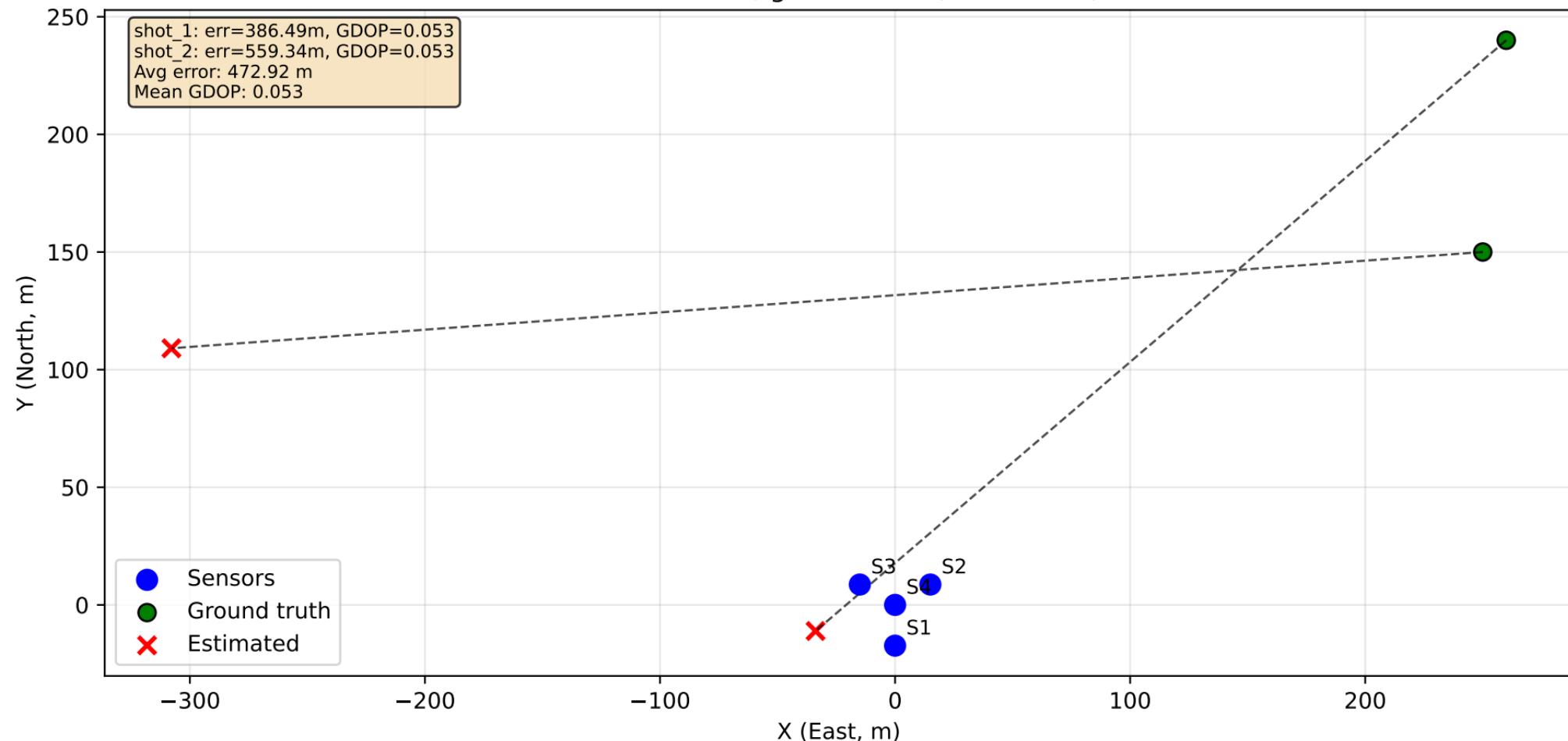


# Part 2: TDOA Localization (GCC-PHAT on per-event chunks, no TOA)

## Localization results: error, avg error, GDOP

Position name	Ground truth (x,y,z) m	Estimated (x,y,z) m	Error (m)	GDOP	Uncertainty (m)	Confidence
shot_1	(260.00, 240.00, 2.00)	(-33.82, -11.10, 2.00)	386.494	0.053	(17.73,9.26,0.00)	0.950
shot_2	(250.00, 150.00, 2.00)	(-307.84, 109.08, 2.00)	559.341	0.053	(160.94,84.05,0.00)	0.950
Summary			Avg error: 472.918 m	Mean GDOP: 0.05		Mean conf: 0.950

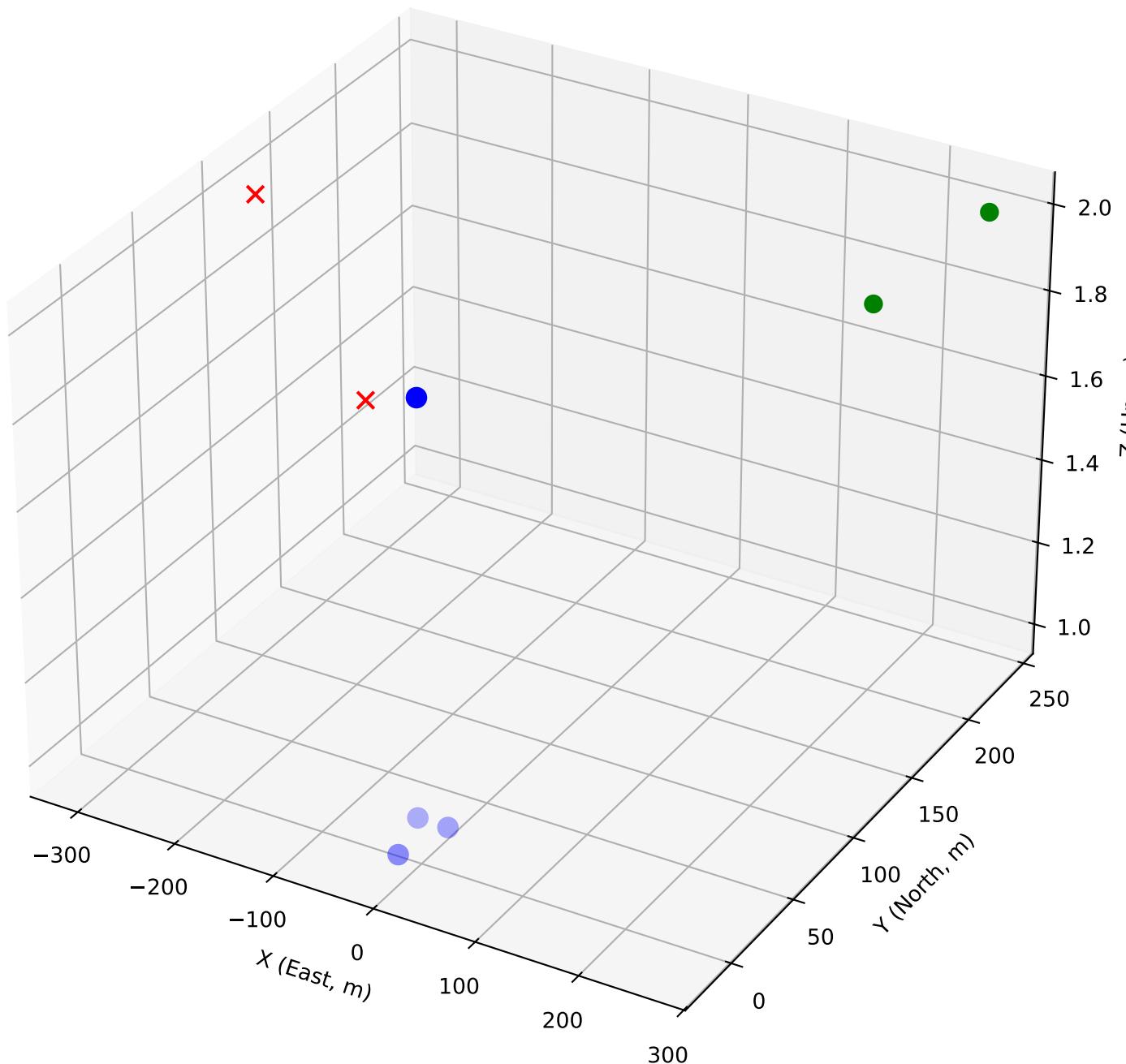
## 2D localization: sensors, ground truth, estimated, error lines



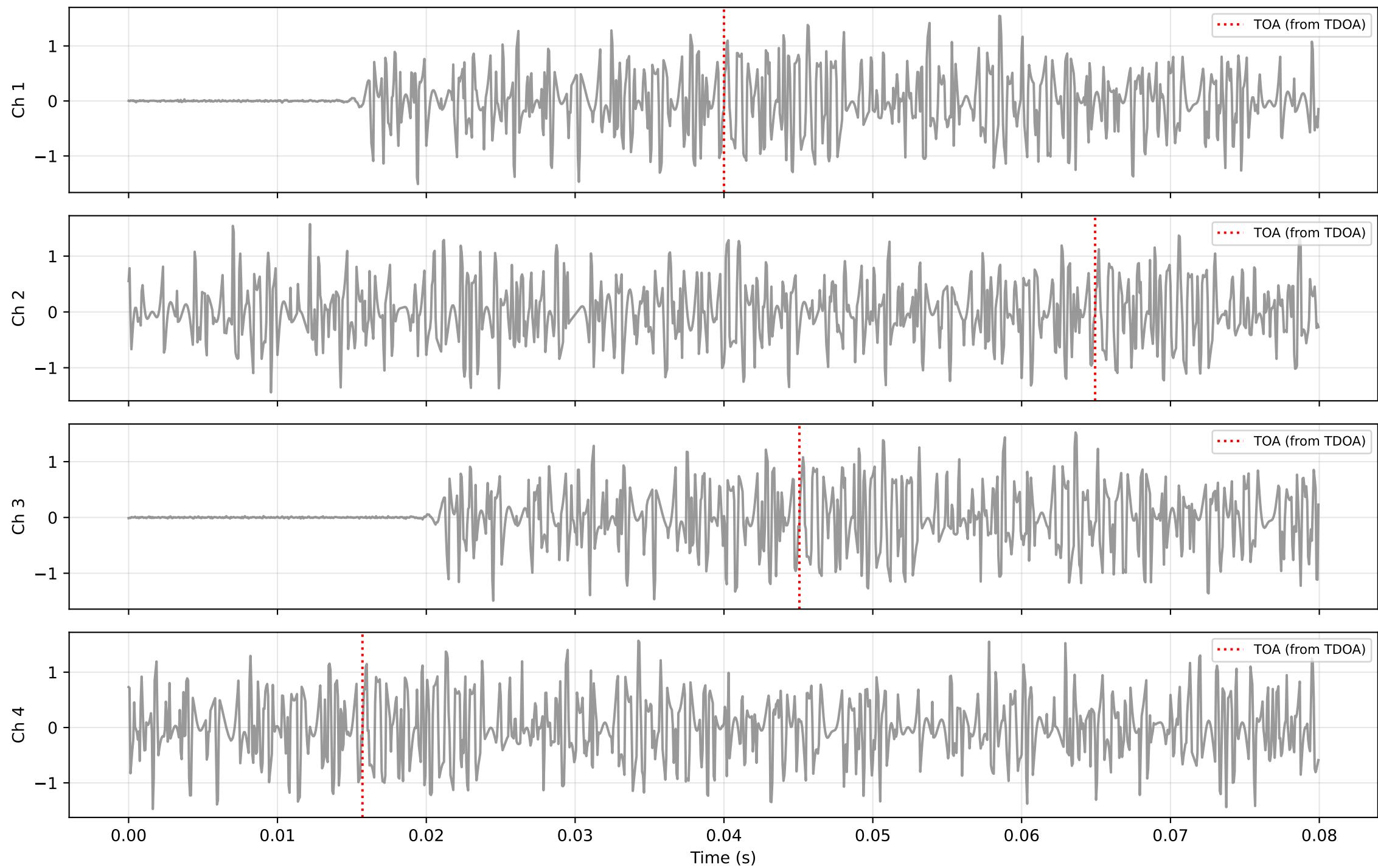
# 3D localization: sensors, ground truth, estimated

Avg error: 472.92 m  
Mean GDOP: 0.053

● Sensors



Waveform: shot\_1 — TOA marks (visualization only, not used in localization)



Waveform: shot\_2 — TOA marks (visualization only, not used in localization)

