GCC-PHAT Processing Chain

Mic Array (4-Ch) →PCM→ Windowing (Hanning) → FFT $\mathcal{F}\{x(n)\}$ → Cross-Power Spectrum $X_i(f)X_j^*(f)$

TDOA Δt ← Peak Search $\hat{\tau} = \arg\max$ ←$R_{ij}(\tau)$← IFFT $\mathcal{F}^{-1}$ ← PHAT Weighting $\frac{1}{|X_i X_j^*|}$

Optical ToF → I2C Read & Quality Check → Distance d Conf C_{opt}

Vision → Geometry Solver → UART Parse → Vis Angle θ_v Conf C_v

Audio Angle θ_a

Fusion Center
1. Check Conf (C)
2. Weighted Avg
3. Kalman Filter

Final State (x, y, θ)