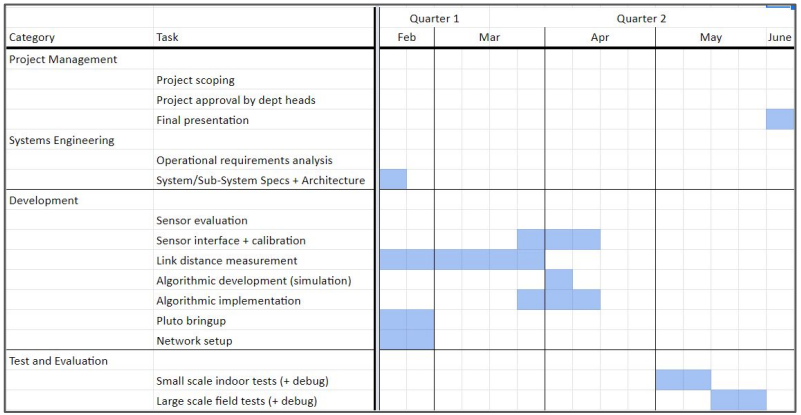
Wireless Sensor Network Localization Progress Update

Trevor Fung
3/4

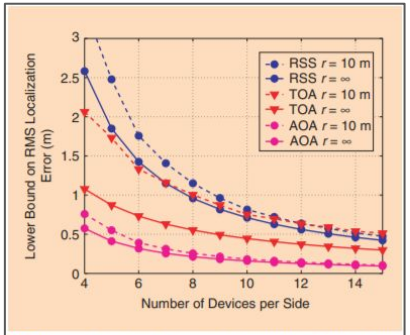
Schedule review

- Previous 2 weeks:
  - Got Pluto testbed up in simple network
  - More reading (literature review)
- Coming 2 weeks:
  - Test different link distance approaches:
    - RSSI (Received Signal Strength Indicator)
    - ToF/ToA (Time of Flight/Arrival)
    - TDoA (Time Difference of Arrival)
    - Hybrid



Distance measurement techniques + Networking

- Literature indicates:
  - ToA generally outperforms RSSI (see upper right[1]) and TDoA (lower right[2])
  - Combinations of measurement techniques outperforms single measurement techniques, as error sources (generally) uncorrelated[3]
- Approach:
  - Get ToA first, RSSI second, TDoA if possible
- Currently using open-source Charon[4]
  - Layer 1: OFDM, liquidSDR library
  - Layer 2: BATMAN-adv (Better Approach To Mobile Ad-hoc Networking)
  - Should be sufficient for simple sensor data packets, “originator” (network maintenance) frame looks tinker-able enough to support ToA (liquid exposes sync frame syms), already has RSSI, unsure about TDoA
    - Fallback if nothing works: Pi-to-Pi WiFi backhaul, Plutos handle distance measurements only



[FIG7] Lower bounds for localization standard deviation for the example described in the text when measurements are RSS (with $\sigma_{dB}/n_p = 1.7$ [24]), TOA (with $\sigma_T = 6.3$ ns [24]), and AOA (with $\sigma_\omega = 5^\circ$). Parameter r is the radius of connectivity; only pairs of sensors closer than r make measurements, and for $r = \infty$, all pairs make measurements.

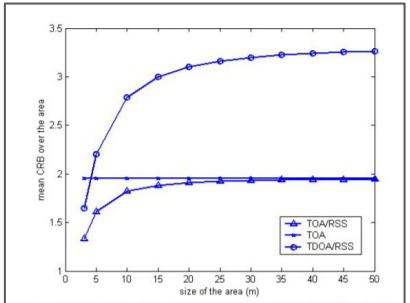


Figure 4 Mean CRB of the TOA, TOA/RSS and TDOA/RSS schemes ($\sigma_{dB}/n_p = 2$ and $c\sigma_T = 1.8$).

1. N. Patwari, J. Ash, S. Kyperountas, I. Hero, A.O., R. Moses, and N. Correal, “Locating the nodes: cooperative localization in wireless sensor networks,” IEEE Signal Processing Magazine, vol. 22, no. 4, pp. 54–69, 2005.
2. Catovic, A., & Sahinoglu, Z. (2004). The Cramer-Rao bounds of hybrid TOA/RSS and TDOA/RSS location estimation schemes. IEEE Communications Letters, 8(10), 626-628.
3. Mao, G., Fidan, B., & Anderson, B. D. (2007). Wireless sensor network localization techniques. Computer networks, 51(10), 2529-2553.
4. https://github.com/tvelliott/charon