Task solution

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1 Amplitude and phase of the estimated channel frequency response

Figures 1 and 2 show the amplitude and phase of the estimated channel frequency responses, respectively.

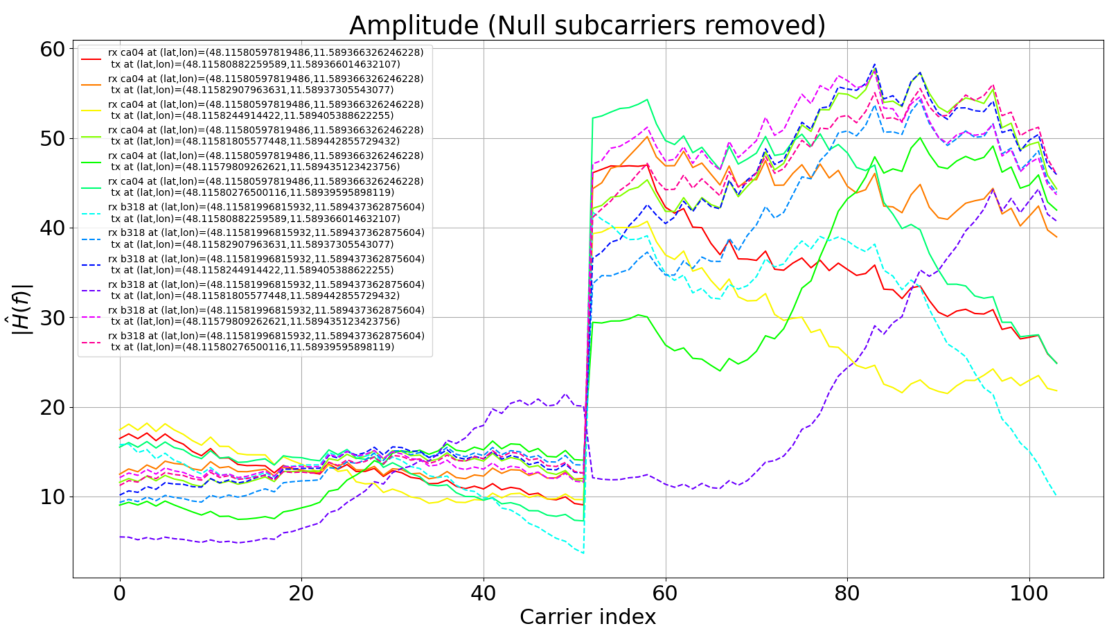

Figure 1: Amplitude of the estimated channel frequency responses

2 Channel impulse response and power delay profile

Figures 3 and 4 show the estimated channel impulse responses and power delay profiles, respectively.

3 RSSI vs distance and power of the direct path vs distance

Figures 5 and 6 show the RSSI vs distance and power of the direct path vs distance plots, respectively.

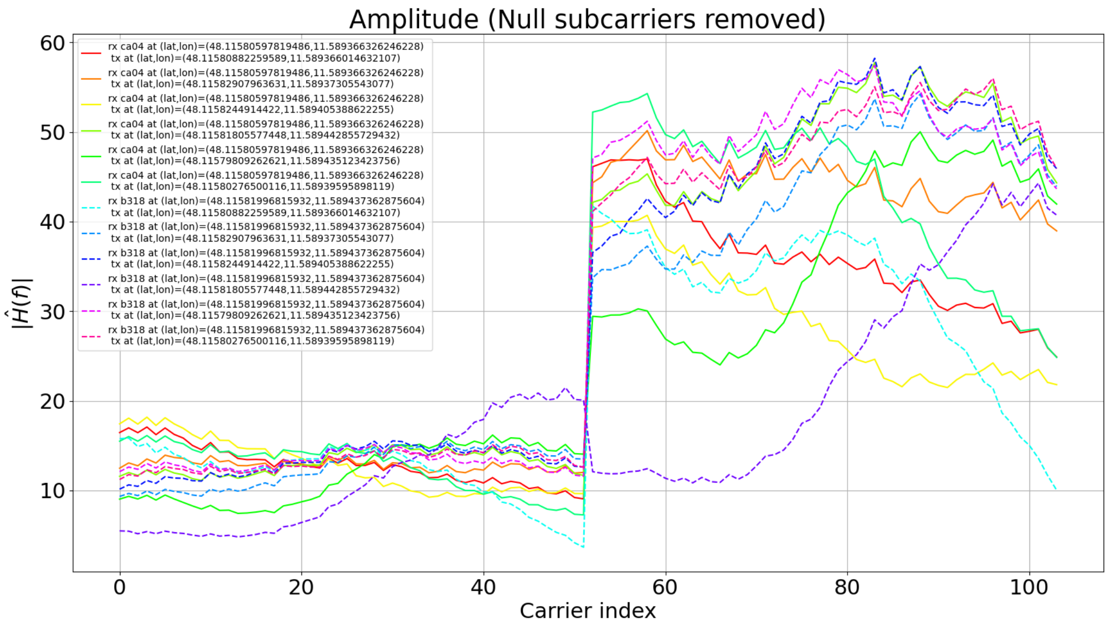

Figure 2: Phase of the estimated channel frequency responses

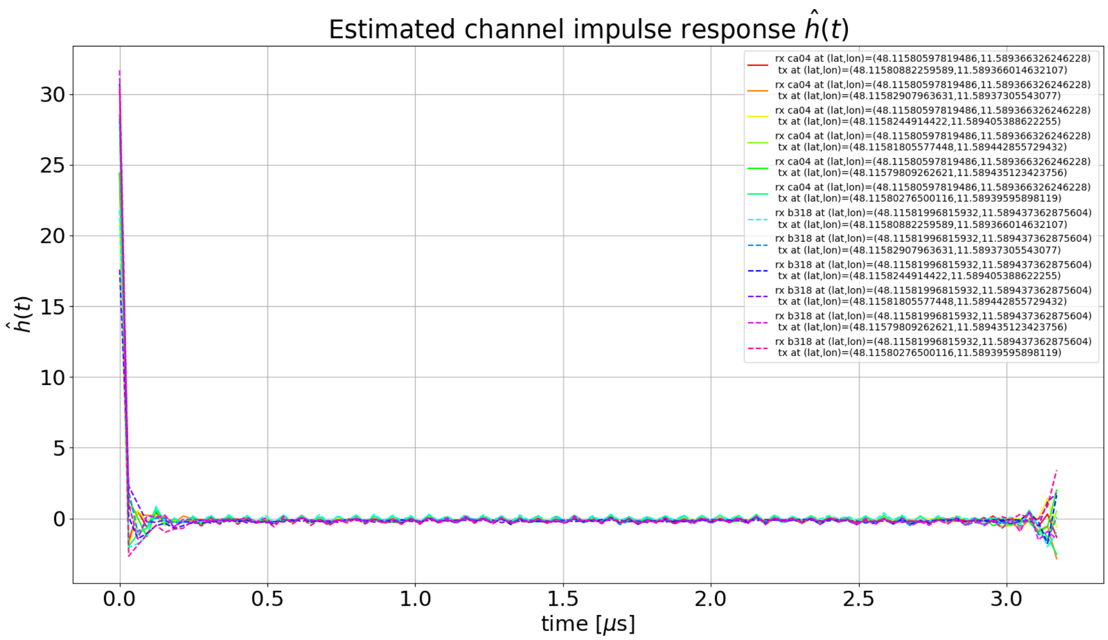

Figure 3: Estimated channel impulse responses

The first delay component of the CIR, which is equivalent to the channel Time-of-Flight (ToF), represents the time taken by the signal to arrive at the receiver from the transmitter via a Line-of-Sight (LoS) path. Therefore, it can be used for localization and, intuitively, it will have a better performance than using RSSI for the same end. A clear example of using this approach can be found in [1]. However, this solution must be taken carefully in indoor scenarios. In WiFi scenarios, a typical frequency band spans 20 MHz of bandwidth (BW), which is equivalent to a resolution of $\Delta_\tau = 1/BW = 50$ ns in the delay domain. Thus, two paths can be discriminated if the difference in

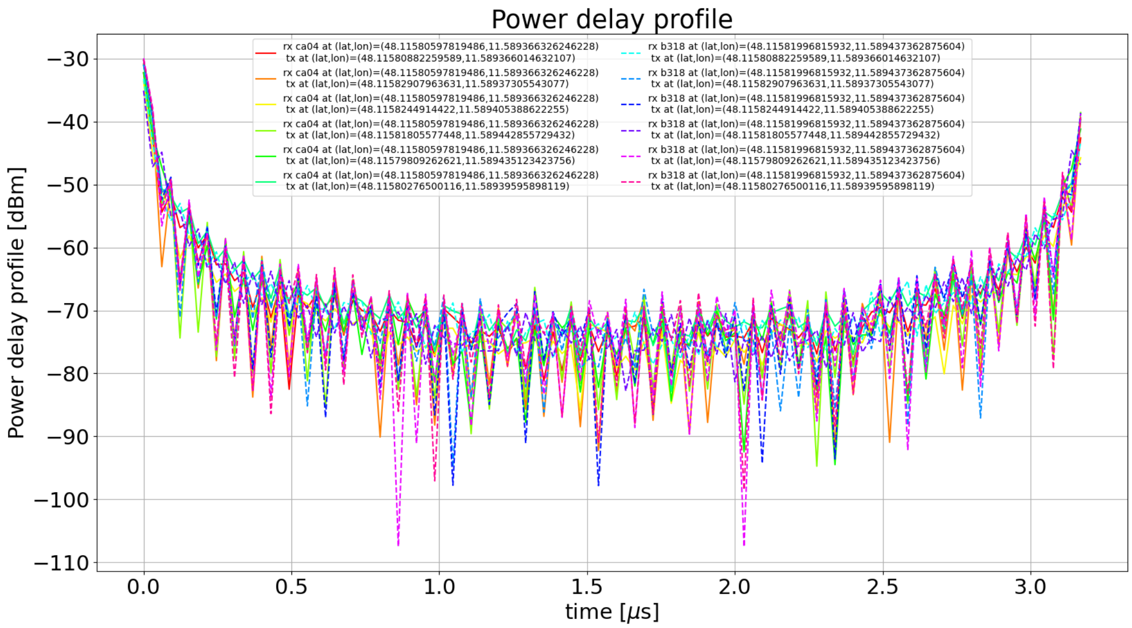

Figure 4: Estimated power delay profiles

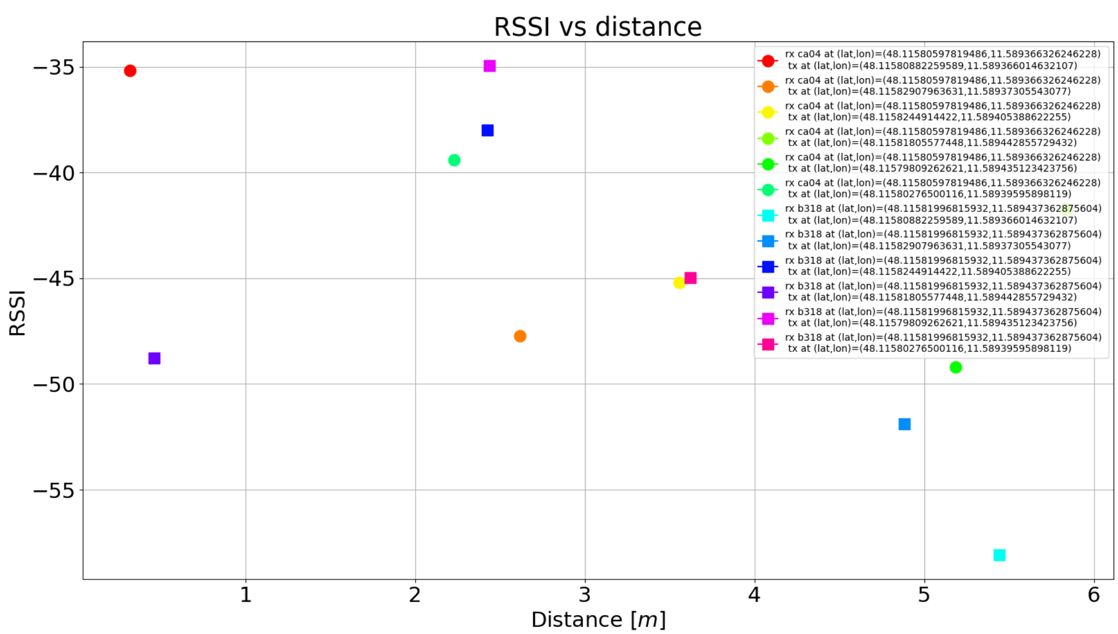

Figure 5: RSSI vs distance

their delays is larger than 50 ns. Considering the light speed of about 3×10^8, the paths' distance must be larger than 15 m, which in indoor environments, it will be a problem. A very interesting solution that faces the above problem is described in detail in [2].

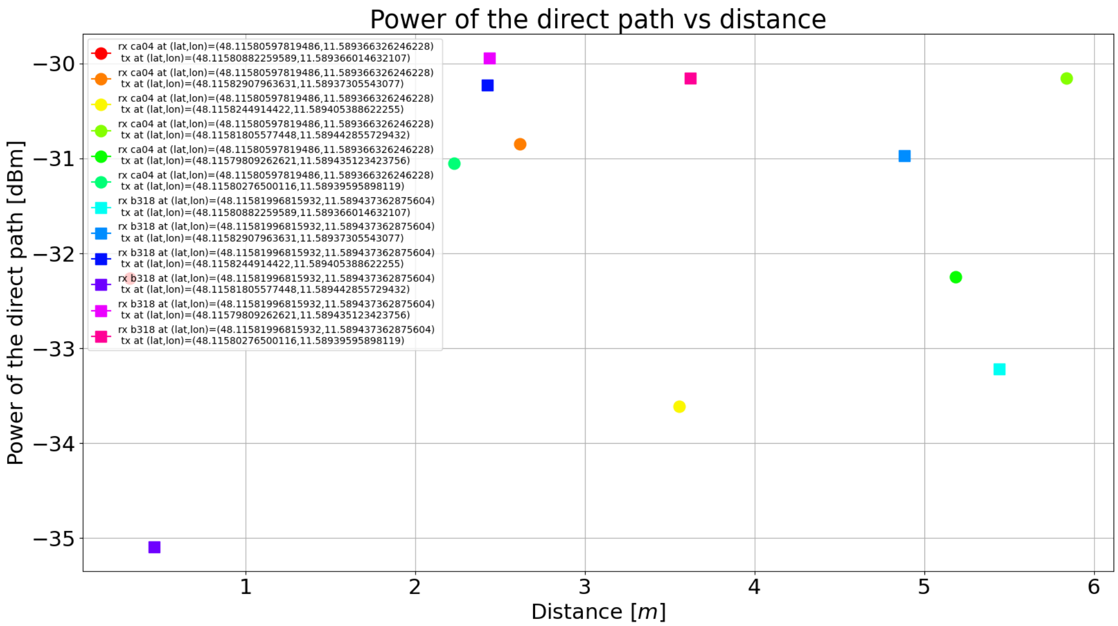

Figure 6: Power of the direct path vs distance

References

References

[1] D. Vasisht, S. Kumar, and D. Katabi, "Decimeter-level localization with a single wifi access point," in *13th {USENIX} Symposium on Networked Systems Design and Implementation ({NSDI} 16)*, 2016, pp. 165–178.

[2] M. B. Khalilsarai, B. Gross, S. Stefanatos, G. Wunder, and G. Caire, "Wifi-based channel impulse response estimation and localization via multi-band splicing," in *GLOBECOM 2020-2020 IEEE Global Communications Conference*. IEEE, 2020, pp. 1–6.