UNIVERSITY OF CAMBRIDGE

Cambridge Cybercrime Centre
COVID Briefing Paper # 14

Acoustic Test and Trace: it sounded like a good idea at the time

Ilia Shumailov

6 October 2020

Executive summary

CCC COVID Briefing Papers are an ongoing series of short-form, open access reports aimed at academics, policymakers, and practitioners, which aim to provide an accessible summary of our ongoing research into the effects which the coronavirus pandemic (and government responses) are having on cybercrime.

In this report we digress into considering COVID-19 testing and tracing, where robust, privacy-preserving systems are required. Bluetooth Low Energy (BLE) is commonly used for exchanging data between devices over short distances, but its use for contact tracing has run into significant problems because of restrictions imposed by Apple on the technologies which many contact tracing apps use. In the UK, these restrictions led to the abandonment of the UK contact-tracing app after it emerged that only 4% of iPhone users were detected [1]. Ultrasonic communications have been proposed to remedy BLE-related problems. Here, we argue that ultrasonics do not provide significant additional benefits, and face significant problems of their own, including some striking failure modes such as false contacts arising from voice and video calls.

Ultrasonic communications

Our lab has previous experience with these technologies, having built a tool-box [2] for ultrasonic communications between smartphones and learned a number of lessons along the way. First and foremost, we found that transmission quality depends chiefly on the angle of the transmitter, achieving optimal quality when this faces in the direction of the speaker. Figure 1 shows how signal quality changes as the angle of the

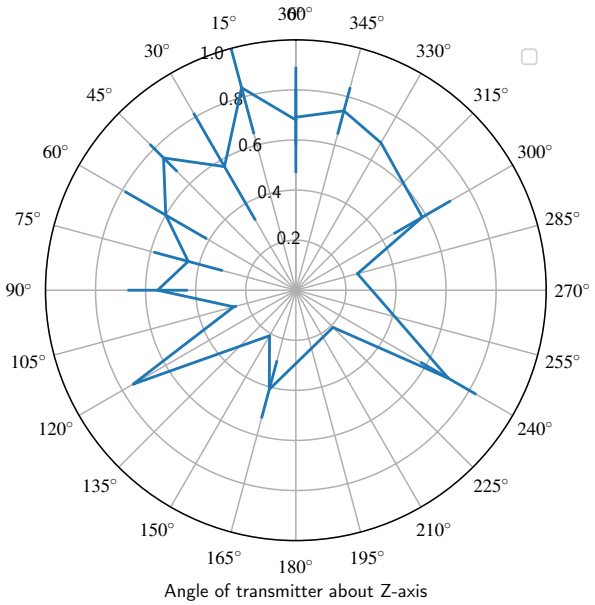

Figure 1: Impact of angle on signal strength

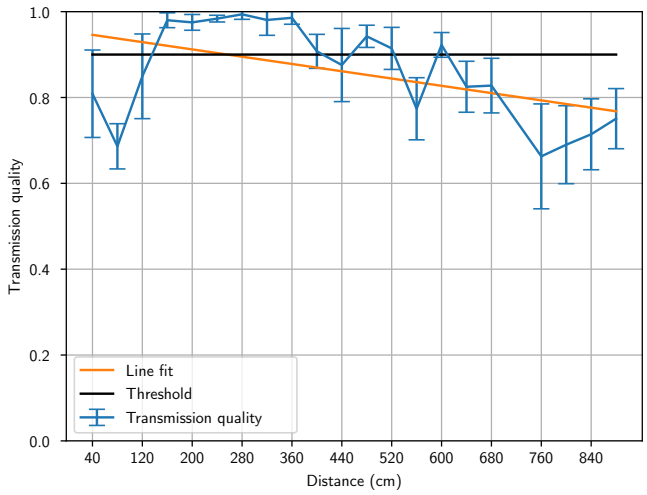

Figure 2: Impact of distance on signal strength

transmitter changes. It is also dependent on the direction of the microphone, but we found that this was not as significant. Our second finding was that ultrasonic transmission was only reliable up to a distance of six metres. Figure 2 shows the dependency of transmission quality on data as distance changes.

It is clear that both angle and distance play an important role in ultrasonic communications with smartphones, yet it is unclear what impact they will have in practical applications. The tests described above assume a static position of the smartphones, but people walk with phones in their pockets and their hands shake when the phone is used, meaning performance will degrade further. There are also likely to be issues in noisy environments, such as screeching wheel noise in crowded tube trains. Interestingly, there are a number of failure modes endemic to acoustic systems. For example, where voice messaging systems do not limit transmit bandwidth to 17KHz this could cause false positives, for example, where everyone on a Zoom call could be marked as co-located in the same room as the signal is transmitted over the call via the microphone and speakers. Overall, it is unclear what benefits acoustics would bring over BLE.

Conclusions

We analysed the possibility of using ultrasonic communications in COVID-19 contact tracing, and concluded that it did not add enough value to the better-known BLE mechanisms to be worth further development effort. Particularly striking failure modes are possible with this approach, such as video calls inadvertently transmitting a positive contact signal to those involved.

References

[1] Tom Lovett et al. “Inferring Proximity from Bluetooth Low Energy RSSI with Unscented Kalman Smoothers”. In: *Alan Turing Institute* (2020).

[2] Almos Zarandy, Ilia Shumailov, and Ross Anderson. “BatNet: Data transmission between smartphones over ultrasound”. In: *arXiv preprint arXiv:2008.00136* (2020).