

# Human Activity Detection Using Radio Waves

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## 1 WHAT WE HAVE LEARNT SO FAR.

First of all, our objective of this project is narrowed down to the detection of the presence of an object according to the result of discussion in the teacher's office. With this, we have reached the agreement that if we manage to achieve Eliminating the Flash<sup>[1]</sup>, in another word, Nulling, we will be able to fulfill the objective. This is because nulling counterbalances the effect of a specific multi-path fading channel, after nulling, any motion of objects within the channel will cause changing of the channel status. As a result, the signal that we receive shall change from null to presence.

With the foregoing conclusion drawn, we focused on flash nulling. So far, we can understand the nulling scheme stated in [1], but we still have difficulty implementing that. The main difficulty lies in channel estimation which cannot be obtained by simple division as stated in the paper.

One high-resolution scheme that can be used to nullify the incoming signal is proposed in [2]. With this, we can estimate the pilot sequence  $p$  which is known to the receiver from received signal  $r$  by the mean of equalization as  $p_{est}$ . If we subtract  $p$  by  $p_{est}$ , we shall get null. Once the channel changes, or an object within it is removed in another word, the previous channel estimation expires, so that the subtraction becomes non-zero. From that, we may conclude an object changes its location. This might be a naive solution.

## 2 WHAT WE HAVE ACHIEVED SO FAR.

We used Matlab to simulate what will happen in actual system. We simulated a scenario of SISO system, generated an arbitrary sequence, got it modulated with QPSK, passed the modulated signal into a multi-path fading channel, simulated processing inside the SDR after reception of the signal, demodulated it, and tried to implement the channel estimation scheme. Now most of the foregoing simulations are completed except the channel estimation one.

## 3 WHAT NEXT.

The challenges we are facing are:

- The channel estimation remains undone;
- What particular kind of transmitting hardware we need is unclear. The hardware we need in transmission end shall send specific message frame whose content, symbol duration, modulation scheme can be modified. Hardware's operation frequency shall reach our SDR's frequency band 24 - 1766 MHz. The hardware may shall be able to coordinate with the receiver in order to precode.

Next we plan to continue studying implementation of original nulling scheme in [1], while test the validity of equalization scheme that we came up with on Matlab. If the latter scheme works, it will decrease the complexity of the system since it only requires signal processing on the receiving end.

Besides, we will investigate specific transmission hardwares that we may need.

## REFERENCES

- [1] E. Adib and D. Katabi. See Through Walls with Wi-Fi! , ACM SIGCOMM, Hong Kong, 2013.
- [2] K. Tan, H. Liu, J. Fang, W. Wang, J. Zhang, M. Chen, and G. Voelker. SAM: Enabling Practical Spatial Multiple Access in Wireless LAN, ACM MobiCom, Beijing, 2009.