PAPER REVIEW

Writeup for:
1) Test bed for a wireless network on small UAVs (paper 25)
2) Design and implementation of an underlay control channel for cognitive radios (paper 26)

1) This paper was a write-up on testbed for UAV command and control. The most useful parts of this paper deal with protocols and the hardware/software interfaces. The main protocol used for command and control was standard WiFi. This paper would be a good introduction into controlling the UAVs using WiFi instead of the more proprietary Zigbee/AODV implementation we are currently considering.

2) This paper considers the combination of both cognitive radio algorithms and filter bank multicarrier spread spectrum. The most interesting parts of this paper is how the two powerful algorithms are used concurrently to reduce radio interference not only to itself, but to other radio communications. Also, this paper was written in Idaho Falls under the same situations we face during this doctorate research process. Personally, I believe this would be a good starting point to really tackle interference and bandwidth as it appears the results are promising and the hardware is affordable.

Writeup for:
1) Design and Impl. of an Underlay Control Channel for NC-OFDM-based Networks (paper 27)
2) A Tutorial on Interference Alignment (paper 19)

1) This paper discusses improvements to Orthogonal Frequency Division Multiplexing (OFDM). The main modification of OFDM is the usage of non-contiguous carrier frequencies, hence the “NC” in “NC-OFDM.” Basically, by using a non-contiguous set of carrier frequencies, the authors of the paper are able to send control and data information in a situation in which large swaths of the spectrum are reserved. Also, the authors of this paper were able to lower the amount of power necessary to transmit on the carriers. Basically, cognitive technologies mixed with low-power OFDM carriers. Interesting tools used: ORBIT testbed and GNU Radio.

2) This paper, while intended for MIMO interference alignment, actually does a good job explaining the topics of interference and noise in the general sense. To begin, there is a discussion on the differences between noise and interference. Interference is the unintended consequence of multiple parties using the same “interference channel.” Most radio algorithms are “greedy” in the sense that a communication pair tend to want to control the entire channel for themselves. This leads to other users of the channel having to deal with high interference levels. The greater the interference, the more complex the algorithms required to clean up communications. The paper explains that a small amount of interference can be “filtered” or “decoded.” But there is no algorithmic solution for massive interference.

While orthogonalizing MIMO communications will not be part of my dissertation, it’s interesting to read about how it’s done and the “degrees of freedom” which must be considered. Basically, the more moving parts in the interference channel, the more variables (“degrees of freedom”) must be computed in order to reduce interference and noise. The topic of “Interference Alignment” is starting to become more understandable to me and this paper helps in that matter. The final topic touched by this tutorial is the idea that networks can either help eachother out, or guess at what everyone else is doing in order to reduce interference. If, for example, all the senders have network state info, they can coordinate their usage of the interference channels in time and space. Thus, the more state info, the less degrees of freedom in the system. Very good paper.

Writeup for:
1) Single Antenna Interference Cancellation Algorithm based on lattice Reduction (paper 24)

This paper attempts to solve interference using oversampling on a single attenna. By over-sampling, the researchers are able to create virtual MIMO signals. This signals are then used to create a lattice of signal vectors which can then be used to cancel eachother out. Basically, this to me feels like something similar to OFDM.

The authors claim that this method is significantly less complex then traditional MIMO algorithms and the complexity scales quadratically depending on channel length. I believe they also claim that modulation techniques used do not increase complexity but I have to read deeper into the paper to understand exactly what they mean. If anything, this paper does a good job surveying many phase shifting procedures common to SAIC reductions.

SIDE PROJECT: AODV Links

The following are excellent AODV introductions:

(The main paper)
https://www.ietf.org/rfc/rfc3561.txt

(research via white paper)
https://www.cs.cornell.edu/people/egs/615/aodv.pdf

(classroom notes)
http://www.cs.jhu.edu/~cs647/aodv.pdf

(great video on AODV trace)
https://youtu.be/wlyibjrHhrs

Writeup for:
1) Radio Interference Detection in Wireless Sensor Networks (paper 16)
2) Single Antenna Interference Cancellation for 8PSK (paper 21)

1) Radio Interference Detection in Wireless Sensor Networks (paper 16)

This paper attempts to make a clear distinction between communication range and interference range. Basically, you can’t assume that because node A is able to communicate with node B, that node A can interfere with others trying to communicate with node B. Basically, the authors are arguing that the assumption that the range of communication and interference are equal is false and it’s unfortunately prevalent in most protocol designs.

The authors of this paper use “RID” and “RID-B” to sample real-world communications and interference between sensor nodes. With the data they collected, they develop an improved TDMA protocol. The improved protocol has shown to provide 100% communications in their simulation environment. Their findings are too good to be true.

2) Single Antenna Interference Cancellation for 8PSK (paper 21)

The authors of this paper explore the problem of two different shift-keying modulations interfering with each-other. Basically, a 8PSK modulated signal carries information intended to be picked up by a single antenna (SAIC situation). During it's flight, a GMSK modulated signal slams into it, causing distortion. The authors argue that all papers they have read on the topic of SAIC protocols, it always involves signals that are modulated in the same fashion. Therefore, their findings are unique and the solution is novel.

The authors noticed that certain modulations (GMSK in particular), have attributes that can be exploited for interference reduction. When the redundancy of GMSK is exploited, the authors are able to suppress the interference in such a manner that only a non-linear distortion remains in the original 8PSK signal. This distortion is filtered out using a modified equalizer and matrix mathematics. Again, virtual antennas are created along with degrees of freedom. The end result is improved gains in reception and a more reliant 8PSK modulation for EGPRS.

Writeup for:

1) A Single Antenna Interference Cancellation Algorithm (paper 22)
2) On the impact of Noise Sensitivity on Performance in 802.11 Based Ad Hoc Networks (paper 30)

1) A Single Antenna Interference Cancellation Algorithm (paper 22)

The objective of this paper is to improve SAIC through algorithms that simplify co-channel interference. Their algorithm, called Mono Interference Cancellation (MIC), attacks the most powerful co-channel interference signal. To begin, the channel is viewed as having certain characteristics. The first of which is the "discrete-time flat fading channel." The paper doesn't go into much detail about what "discrete-time flat fading" means, but rather, just gets to the point with vector mathematics. The next channel characteristic is the "Fading ISI Channel." Again, not much detail as to what the problem is, but rather, a mathematical model of the filter used to solve the issue is given. Lastly, this paper discusses the mathematical modeling of the MIC.

This paper feels more advanced then many I have read. The reason being is that it goes right into the theory rather then describing the scenario. This paper assumes the reader has a deeper understanding of mathematical theory behind single antenna interference and linear algebraic modeling of multiple electromagnetic frequencies. What is interesting, though, is that the writers of this paper did do actual field tests and they had great success. One simple thing I learned is the difference between co-channel interference and adjacent channel interference. Simple, but yet still important to know the difference between the two.

2) On the impact of Noise Sensitivity on Performance in 802.11 Based Ad Hoc Networks (paper 30)

This is a critical paper that is directly related to the work we are doing. To begin, it discusses a lot of the MAC assumptions we make. The virtual carrier sense, for example, has a tendency to back-fire in a large ad-hoc network. It's even mentioned that algorithms such as AODV are negatively impacted by MAC-layer carrier sense. Unfortunately, the solution they present in this paper was only tested using simulations. Regardless, their findings might prove useful.

This paper explores the issues regarding the unwavering trust the MAC layer has in regardings to measuring noise, properly adhearing to the request to send/clear to send protocols (RTS/CTS), and it's ignorance to the idea that the reciever might be busy with individuals that the sender can't sense in the environment. The writers of this paper forcefully relax many of the rules and protocols that the

MAC layer abides by. In doing so, they were able to improve thoughput by 11% and reduce routing of packets by 30%. This paper would be a good start in our research.