

Digital Communications – SDR Project

Guide to Work through the 802.11a Receiver Article

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Week 1

- Lookup the 802.11a OFDM system design parameters
 - Bandwidth, sub-carrier spacing, number of sub-carriers, IFFT/ FFT size, number of data sub-carriers, number of pilot sub-carriers
 - Why are there unused sub-carriers and where are they located?
 - OFDM symbol duration, sampling rate, OFDM symbol length (samples), cyclic prefix length
 - Frame prefix sequence, length, repetition, duration
- Read section 2.1 and understand what it means
 - Where are the mentioned tags?
- Work yourself through Section 2.2
 - Identify the blocks that calculate the autocorrelation
 - Identify the blocks that calculate the power
 - Try to obtain a graph like Figure 2
 - Explore the effect of varying N_{win} , e.g. in the graph like Figure 2
- Week 2
 - Understand the *OFDM Sync Short* block
 - What does the block do
 - What is the meaning of the thresholds
 - Explore the effect of changing the thresholds
 - Understand the limitations of the approach taken, and try to demonstrate a case where it breaks
- Week 3
 - Understand the block *OFDM Sync Long* (Section 2.3)
 - Understand the algorithm for frequency offset correction.
 - Where it is implemented?
 - Which parameters could you vary?
 - Why is there a delayed input? Could you change that value and what would the impact be of doing that?
- Week 4
 - Understand symbol alignment (Section 2.4)
 - How is symbol alignment done (algorithm logic)?
 - Why is matched filtering used for symbol alignment but not for frame detection?
 - Have a look at the code that implements equation 6.
 - Why do you add 64 in expression 7?

- What does the stream to vector block do?
- Week 5
 - Understand Phase Offset Correction (Section 2.5)
 - Why do you need to correct the phase?
 - Find the code that estimates the phase offset
 - How are you correcting the phase, i.e. which values are being changed?
- Week 6
 - Understand the *OFDM Equalize Symbols* module
 - What does it do?
 - Why is the implementation limited to deal with BPSK and QPSK modulation?
 - Which other functions are performed in this block?
 - Work through Section 2.7
 - Look up the frame format for 802.x frames and how the data in the initial fields is transmitted. You are already looking into the MAC layer.
 - Recall what you learned in Computer Networks course about framing. How can you delimit a frame?
 - What is the Signal Field? Which information is sent there? Why is this information necessary?
 - How is that information encoded?
- Week 7
 - Work through decoding the payload (Section 2.8)
 - Which abstract receiver blocks are within the module *OFDM Decode Mac*?
 - How many constellation symbols are demodulated at once? Why? Can you change this? What is the impact of changing this?
 - What is the actual process of digital demodulation? What is the input and the output, and how is the conversion done?
 - Look at the code if necessary.
 - Understand what is de-interleaving.
 - Watch the video in Panopto explaining what is de-interleaving.
 - Find the code that does de-interleaving and understand it.
 - Understand de-scrambling
 - What is scrambling/ descrambling? Why is it used?
 - How can the receiver de-scramble without explicit knowledge of the scrambler initial state?
 - Which fields of the received frames are used and how?
- Week 8
 - Understand the decoding (Section 2.8)
 - Will add detailed questions about the decoding later
 - Try out your 802.11a receiver with a real 802.11a access point. Can you see the received frames?
 - Read Section 8 (Interoperability)