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| OFDM SYNCRONIZATION USING USRP2 AND MATLAB |
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OFDM SYNCRONIZATION USING USRP2 AND MATLAB

DR. Mohammed Khairy

**Abstract:**

OFDM is a multi-carrier system where data bits are encoded to multiple sub-carriers and sent simultaneously in time. The result is an optimum usage of bandwidth. A set of orthog- onal sub-carriers together forms an OFDM symbol. To avoid ISI due to multi-path, successive OFDM symbols are separated by guard band. This makes the OFDM system resistant to multi-path effects. Although OFDM in theory has been in existence for a long time, recent developments in DSP and VLSI technologies have made it a feasible option. This project describes the implementation of OFDM transceiver according to 802.11a standard on USRP2 kit taking into consideration the most important issue of communic- ation system which is the synchronization between the transmitter and the [receiver](http://www.google.com.eg/search?hl=ar&biw=1024&bih=624&sa=X&ei=eaceTuewFMbDtAaMx-CgAg&ved=0CCsQBSgA&q=receiver&spell=1) , Also the SDR is the technique of getting code as close to the antenna as possible. It turns radio hardware problems into software problems , so this project represent new methods to implement and test the communication system instead of simulation only to apply [reliable](http://www.google.com.eg/search?hl=ar&biw=1024&bih=624&sa=X&ei=bqgeTrmTO4rwsgbK8LD_AQ&ved=0CB8QvwUoAQ&q=reliable&spell=1) solution for wireless problems such that multipath time varying fading…etc , this methods based on using real communication system implemented on USRP kit family and apply the proposed techniques or algorithms to improve the quality of wireless system.

**CONCLUSION:**

we have investigated the frame synchronization problem. Since this has vital importance for the OFDM systems, we focused on the OFDM symbol synchronization, inherently the frame synchronization problem.

We have first investigated the OFDM system. OFDM is a multi-carrier modulation scheme used for bandwidth efficiency, immunity to multipath effects and ISI. The main idea behind OFDM is to convert a single convolutional channel into a number of parallel, low bit-rate flat fading channels. Therefore, equalization can be done easily and only a single tap is enough for each subchannel. The parallelism is established using orthogonal subcarriers and cyclic-prefix. Orthogonal subcarriers are generated by inverse discrete Fourier transform and cyclic prefix turns the linear convolution with the channel into a cyclic convolution. Cyclic-prefix together with the orthogonality eliminates the ISI and ICI.

OFDM has also certain disadvantages. First, orthogonality must be ensured throughout the communication. Even a small offset in the carrier frequency or phase disturbs the orthogonality condition, hence introduces ICI. Second, symbol (frame) timing must be precise. The FFT window at the receiver must be free from samples of the adjacent OFDM symbols. If not, the extracted OFDM symbol is contaminated with the samples from the previous OFDM symbol because of the channel memory.

We considered the frame synchronization techniques applied in the single carrier schemes. The popular way of frame synchronization is to indicate the start of frame by a marker. The marker is selected such that its correlation must be able to indicate itself in the noisy environment. The frame is detected at the receiver by correlating the received sequence with the known marker. An alternative to marker is to use gaps between the frames. The receiver aligns the frames considering the received signal power. Another alternative is to copy a part from the end of the frame to the start of the frame. In this case, the receiver correlates the data with itself and does not need to know a predefined sequence. However, these methods decrease the transmission efficiency since already known symbols are sent throughout the frames.

We investigated the OFDM system and analyzed the receiver structure in more detail. What we have to do at the receiver side is first to detect the start of the frame and the symbol boundaries. Secondly, frequency offset must be estimated and corrected. As the third task, the channel frequency coefficients on the subcarriers need to be estimated and equalized. The ideal detection of symbol boundaries is required to avoid ISI. However, it is pointed out that an ISI-free region in the cyclic-prefix exists and ideal synchronization is not necessary as long as the FFT window starts from a sample in the ISI-free regionAfter locating the symbol boundary, the channel estimation and equalization must be done on the subcarriers. For this purpose, a symbol with known carriers is sent and the received subcarriers are compared at the receiver yielding the least squares estimates of the channel frequency response. The 802.11a frame structure supplies fixed symbols for channel estimation. However, although the channel is estimated correctly, if the channel has deep fades in its frequency response, the equalization may result with the amplification of noise. We point out that minimum requirement for an OFDM symbol synchronizer is to locate the frame start at the ISI-free region if the channel estimation is carried out using the same alignment. If the synchronization and estimation are not performed jointly, then either task should be completed free from errors. However, in joint synchronization and estimation, we compensate for the error of the synchronizer with the channel estimator and equalizer yielding the same performance with that in the ideal case.