CHAPTER 5 CONCLUSION

5.1 Introduction

In the previous chapters, we have proposed an SNR estimation technique for OFDM systems and evaluated its performance. In this chapter, we conclude the entire work and suggest future work to further the research in this area.

5.2 Conclusion

In this thesis, a novel SNR estimation technique for OFDM is investigated. Most of the SNR estimation techniques discussed in chapter 2 are for single-carrier systems. There is not that much work conducted for OFDM systems. All the estimators discussed in the literature derive the symbol SNR estimates solely from the received signal at the output of the matched filter assuming intersymbol interference (ISI)-free output of the MF (the decision variable). However, in practice, multipath wireless communication gives rise to intersymbol interference, especially in indoor and urban areas. In these ISI dominated scenarios, SNR estimators that do not presume ISI-free reception are highly desirable. Thus, we are able to establish the motivation and build the foundation to the problem of SNR estimation with the aim of providing the most accurate SNR estimates at the front-end of the receiver.

Looking forward to evaluate and test the performance of our proposed SNR estimation, a complete end-to-end OFDM-FBWA system has been developed in Matlab® in both frequency non-dispersive and dispersive channels with real additive white Gaussian noise (AWGN) and also with colored noise.

To be able to estimate the SNR estimates at front-end of the receiver effectively, we have set ourselves 2 objectives – firstly to select the training signal called preamble which is already in use for OFDM systems, so there will be no extra overhead on the system to perform SNR estimation and secondly, to develop an improved SNR estimation technique with minimal estimation error in mean square error (MSE) and estimated SNR.

We successfully developed an improved SNR estimation technique for OFDM systems. The SNR estimation technique, unlike others, performs noise power and SNR estimation at the front-end of the receiver. We have used the OFDM synchronization preamble for our SNR estimation technique so there would be no additional throughput penalty. The SNR estimation technique developed herein consists of two parts. In the first part, SNR estimation technique for AWGN channel has been developed. In the second part, the SNR estimation technique has been extended to include different noise power levels over the OFDM sub-carriers. The OFDM band has been divided into several sub-bands using wavelet packet and noise in each sub-band has considered white. The second-order statistics of the transmitted OFDM preamble has been calculated in each sub-band and the power of the noise has been estimated. Therefore, the proposed SNR estimation technique estimates both local (within smaller sets of subcarriers) and global (over all sub-carriers) SNR values. The short term local estimates provided the noise power variation across OFDM sub-carriers. When the noise is white, the developed SNR estimation technique works as good as the conventional noise power estimation schemes, showing the generality of the proposed method. We have obtained the simulation results for the proposed technique and compared them with those of previously published estimators for OFDM systems. These results show the superior performance of proposed SNR estimation technique in terms of accuracy of SNR estimates as measured by mean of mean squared error (MSE) and estimated SNR.

We have developed a novel front-end SNR estimation technique in OFDM systems based on one OFDM preamble that shows superior SNR estimation performance. This technique can be employed in practical OFDM systems.

5.3 Suggested Future Works

A possible extension of this work is to undertake the investigation of MIMO technique that enables separate and independent data streams to be transmitted simultaneously from different transmit antennas. This effectively increases the data rates without any expansion in bandwidth.

The front-end based developed technique in this work can be used for efficient inline diversity combing. There are several techniques in wireless communication systems to combat, or even exploit, the detrimental effect of fading channels. The most popular technique is the diversity combining technique, where multiple replicas of the same signal are used to reduce the amount of fading. By coherently combining these multiple copies of the transmitted signal, this technique provides reliability of the communication link and offers a higher dynamic range.

SNR estimation can be used to implement power control algorithms. In wireless communication systems, power control is applied to dynamically adjust the transmitted power according to some chosen criterion to meet the required SINR at the receiver. It represents a flexible tool for exploiting the degrees of freedom offered by the wireless channel. There are a variety of motivations behind the use of power control, including maintaining communication quality in the presence of fading and user mobility.

It is also worthwhile to investigate the problem of adaptive modulation in OFDM systems where an intelligent algorithm controls the modulation and forward error correction code used based on prevailing SNR conditions. The performance of adaptive modulation depends directly on how well the channel SNR is estimated. The more accurate the estimation of the channel SNR is, the better the choice of modulation scheme becomes, and the better the ability to exploit the variations in the wireless channel is. A higher data rate burst is used when the SNR is high and a more robust but lower data rate burst profile is used when the SNR is low.

As we can see, there are many interesting and ground-breaking research work that can be undertaken as a follow-up to the work that we have done in OFDM systems.