CHAPTER 7

CONCLUSIONS

We conclude the thesis by summarizing the important results of the present work. Also we discuss some suggestions for further work.

In our work we have first considered a study of the TCM schemes for applications on AWGN channels. Several Trellis-coded modulation schemes designs have been presented and performance evaluation of various TCM schemes for applications on AWGN channel has been discussed.

From the error performance characteristics of various TCM schemes we note that the 4-state TCM schemes achieve a gain of nearly 3dB over an uncoded reference system, without compromising the spectral efficiency or power efficiency. With 8-state TCM scheme the coding gain obtained is approximately 4dB. Also, we found that the simulated results lie well within the upper and lower bounds on the error event probability, obtained through the derived bounds.

We have next considered in our study, several TCM schemes for transmissions over band-limited ISI channels. TCM scheme in combination with the MLSE equalizer promises to provide the optimum performance, which is very close to ISI-free performance but the computational complexity of the combined MLSE receiver grows exponentially with ISI memory length. This prohibits the practical implementation of combined MLSE receiver, which motivated an active research for the development of reduced complexity receiver structures.

Further, we have considered several combined ISI-code trellis structures for the optimum detection of the Trellis coded QAM signals in the presence of ISI and AWGN. Their error performance has been obtained for transmission on a variety of ISI channels in the presence of AWGN, through computer simulation and the error performance evaluation has been presented. It is noted that, combined MLSE receiver structures for the decoding of Trellis-coded modulated signals does achieve a coding gain of about 2 to 3dB relative to the uncoded MLSE structure designed for band-limited ISI channels in the
presence of AWGN, for the same data rate, bandwidth and signal energy. We have considered the design of some of the reduced complexity the receiver structures obtained through the techniques: channel truncation and the idea of set-partitioning which is inherent in TCM design. The error performance of these sub-optimum receiver structures have been evaluated through simulation for a variety of communication channels and the results are presented. It is noted from simulation results that the truncated combined MLSE structure achieves performance which is close to the performance combined MLSE structure for truncation length J→L. It is observed that RSSE techniques shows an improved performance over uncoded RSSE structure with a performance degradation of about 0.4 dB to 1 dB at an error rate of $10^{-5}$ over combined MLSE structure. It is noted that the simplest structure of RSSE that is PDFD receiver structures show the gain improvement of 2.5 to 3 dB over uncoded PDFD receiver performance though we find a drop in the performance gain relative to the truncated MLSE receivers. Though RSSE provides a performance close to optimum MLSE performance the decisions which are being used to cancel out the residual are not the true estimates as they are derived from the path history. This leads to the possibility of error propagation.

Proposed sub-optimum receiver structures such as Iterative-Decoding and Extended-Refined Iterative decoding provides improved performance over PDFD with slightly increased complexity. With the Trellis-states complexity being same as that of TCM encoder complexity, the proposed techniques approaches the performance of higher complexity RSSE structures.

**SUGGESTIONS FOR FUTURE WORK**

Our work is constrained to the study of two dimensional Trellis-coded QAM schemes over bandlimited ISI channels. However, four dimensional TCM schemes are practically in use. The present work can be extended to multidimensional TCM schemes. Proposed decoding strategies provides refining of noisy received symbols sequence iteratively which can be extended to fading channels.

In recent years, there is an increased interest in the use of Trellis Coded modulation scheme to generate new codes to achieve higher gain which find applications in advanced communications. Accordingly a further work in the direction of improving the performance of reduced complexity suboptimum decoding strategies and to develop new decoding algorithms for the advanced applications could be worth investigating.