CHAPTER 7

CONCLUSIONS

Rapid increase in users and the requirements of multi-media services with high data rate have resulted in the emergence of successive generations of cellular systems from the first generation (1G) to the fourth generation (4G). However, this has certain unresolved problems affecting the performance and is unable to increase the capacity beyond certain limits. This led the researchers to look for better schemes and application of many techniques either in single mode or in combinations.

In this direction many developments have occurred. Multi-carrier techniques of various types have been investigated to cope with the high data rate transmission. OFDM and CDMA techniques are being used with assortments of limitations. This led to the development of MC-CDMA systems, simultaneously exploiting the advantages of CDMA, for increasing the capacity and OFDM, a multi-carrier modulation scheme to reduce the interference. With high spectral efficiency and data rate, MC-CDMA system has been a great promise for the next generation wireless communication systems. Nonetheless when used in multi-path scenario; fading, shadowing and delay spread leads to ISI, multi-cell and co-channel interference. Diminishing the multi-cell interference not only improves the performance of the system but also increases the capacity of the system. Site diversity techniques are generally employed to overcome multi-cell interference. Site diversity techniques involving various types of space time codes to mitigate multi-cell interference have been visualized in this thesis.

Site diversity technique involving various types of space time codes was employed to mitigate multi-cell interference. STBC based site diversity technique is
proposed to reduce multi-cell interference of MC-CDMA and is extended to
D-STBC based site diversity technique. Site diversity technique based on STTC
which holds coding gain in addition to diversity gain and B-SSTC, having equal
probability of constellation points is propounded. STTC based STBC and STBC
based STTC site diversity techniques are also put forward to reduce the error rate of
the system in terms of SER. In addition, with the introduction of balanced points,
B-STTC based STBC and STBC based B-STTC site diversity techniques are
introduced to MC-CDMA system. It is disclosed by investigations that STBC based
B-STTC site diversity technique surpasses all other site diversity techniques in
plummeting multi-cell interference. Further, it is divulged that the increase in
number of receive antennas provides better performance than with the increase in
number of transmit antennas. Moreover, increase in performance of the system pave
way for the increase in capacity of the system.

7.1 RESEARCH CONTRIBUTIONS

Site diversity technique using STBC is proposed for MC-CDMA system
and described in chapter 3. It reduces multi-cell interference by utilising the
diversity gain of STBC. Performance of the system is examined by means of
simulation. The reduced SER obtained in simulation showed that the proposed
 technique achieves significant improvement in performance. Further, the system
performance is evaluated using D-STBC site diversity. The system is evaluated
using multiple (two, three, four and five) combination of transmit and receive
antennas. The result exposed that the increase in number of transmit and receive
antennas progressively improved the performance of the system. It is due to
maximum utilisation of diversity that takes place in the system. Further, simulation
result also revealed that D-STBC based site diversity outperforms STBC site
diversity

STTC based site diversity technique is propounded for MC-CDMA
system in chapter 4. This technique outperformed D-STBC site diversity as STTC
offers coding gain in addition to the diversity gain offered by the block codes. Performance of the system is further evaluated by extending to B-STTC site diversity. System with B-STTC site diversity (built with equal probability of constellation points) does better than the system with STTC site diversity. Further the system is evaluated with multiple (two, three, four and five) combination of transmit and receive antennas. Significant improvements in performance of the system with increase in number of transmit and receive antennas are noticed. Maximum improvement of performance is achieved with the combination of five transmit and receive antennas.

Chapter 5 explains STTC based STBC site diversity technique for MC-CDMA. Increased diversity gain is realised by this combination of space time codes as data is trellis coded before feeding to STBC encoder. Simulation results disclose that this technique surpasses B-STTC site diversity technique in reducing multi-cell interference. Further, the system is analysed with STBC based STTC site diversity technique. Performance of the system increases in terms of reduced SER when transmit and receive antennas is increased in numbers from two, three, four and five. STBC based STTC combines the coding gain of STTC with diversity gain of STBC and outclass the performance of STBC based STTC site diversity technique.

This work also considers B-STTC based STBC site diversity technique in chapter 6. The data is coded with B-STTC before it is fed to the STBC encoder which accumulates more diversity gain when compared to STTC based STBC. The simulation result shows that this technique outshines the performance of the system using STBC based STTC site diversity in combating multi-cell interference. Site diversity analysis of MC-CDMA system is extended to STBC based B-STTC site diversity technique. Result discloses that the performance of the system increases with the increased number of antennas in transmitter and receiver. Also, the performance of the system with STBC based B-STTC outsmarts B-STTC based STBC site diversity technique. Moreover, simulation result reveals that the system
with increase in number of receive antennas provides better performance in error rates than with increase in number of transmit antennas.

The outcome of the present work shows that the alleviation of multi-cell interference is obtained to a great extent for STBC based B-STTC site diversity when compared to other site diversity techniques. The concept proposed in this work, if incorporated in services beyond 3G, increases the quality and capacity which benefits both the subscribers and service providers.

7.2 SCOPE FOR FURTHER WORK

There are number of issues arising as a result of this study that can be further explored.

i. Site diversity technique employing space time codes can be applied to MC-CDMA system over optical wireless channel to analyse its performance.

ii. This work can be integrated along with power control to enhance the quality and capacity of the system.

iii. Space time codes with layered architecture can be engaged to improve the system performance along with spatial multiplexing.

iv. The real time implementation of the system using hardware components like field programmable gate arrays (FPGAs) and firmware DSPs can be worth exploring.

v. The proposed work can be further applied to CWP-MC-CDMA system.