Chapter 6

Conclusion

The demand of higher throughput and higher link quality must be the target of future wireless communication system, since various multimedia or home applications will be provided and thus reliable and affordable technologies are required to realize those contents. Coupled with a robust and efficient OFDM air interface, MIMO technologies can lead to a very attractive high-speed data transmission solution for future wireless systems. Recent years, researches on the topic of MIMO-OFDM system have been exploited greatly, and the MIMO-OFDM based standard, IEEE 802.11n, is just on the stage of competition for two proposals from TGn Sync and WWiSE, respectively. This encourages us to build up a hardware prototyping system based on MIMO-OFDM instead of the theoretical analysis only. In addition, we also investigate the channel condition suitable for each of three space-time algorithms we intend to verify in the system.

The fast prototyping system is built up by the Aptix MP3CF platform, where three FPGA modules, one DSP module, and one USB module are installed. Signal processing on FPGA enables us the construction of a datapath that precisely matches the requirement of computation and memory access for a specific algorithm, whereas that on DSP provides us an easier programming and debugging environment but has less efficiency of execution since memory larger than required is usually allocated. By using USB module, we can integrate the web camera on PC with USB interface into our system, which makes the implementation more lively and interesting.

This thesis has described the signal processing concepts and algorithms of a

MIMO-OFDM system in the physical layer. In addition, a total solution of how to build up a fast prototyping system is provided, including the introduction of integrated platform, programmable modules, and other peripheral modules, and these materials could be a good guidance for those who are on the stage of setting up a new development environment. Moreover, we also provide the detailed designs for the adaptive 4×4 MIMO-OFDM system, containing the design concept in transmitter of DSP, the circuit diagram in both transmitter and receiver of FPGA, and the detailed space-time decoding algorithms in receiver of DSP, which can prove that the hardware realization is indeed performed. Then, according to the experimental results, a mode selection scheme is presented to select the most appropriate space-time algorithms under various channels. The method is simply to identify the channel condition first by the condition number, and then to look up the corresponding tables. In the performance evaluation, we have shown that an adaptive 4×4 MIMO-OFDM system can perform better than the same system without adaptive mechanism (i.e., mode selection scheme) under a varying channel condition.

Feeling that the knowledge of hardware implementation is highly empirical, we compile some useful experiences during implementation as an independent chapter in the last part of the thesis, where lots of precious experiences are included. Moreover, a series of problems arising and their solutions are demonstrated in the example of replacing DFT block to FFT block. Finally, although there is still a lot of room to improve, we believe that the fast prototyping system we proposed is highly advanced nowadays.