

## SUMMARY OF Ph.D. DISSERTATION

School Open and Environmental System	Student Identification Number	SURNAME, First name MIYAZAWA, Takaya
Title A Study on Mitigation Techniques of Multiple Access Interference in Optical Code-Division Multiple-Access Communication Systems		
Abstract Recently, optical code-division multiple-access (CDMA) gains more attention in local-area and access networks, due to its potential advantages for simple protocol and configuration, enhanced information security, as well as enhanced flexibility in the granularity of the provisioned bandwidth. In optical CDMA systems, each user encodes an optical pulse according to an assigned code sequence to achieve flexible multiple-access of large network capacity. Optical CDMA systems suffer from multiple access interference (MAI) originating from other simultaneous users, which causes degradation of bit error probability (BEP). Conventionally, the effect of MAI has been mitigated by using three techniques such as applications of error correcting codes, MAI suppressing techniques and modulations. However, in order to increase the bit-rate or number of simultaneous users at the same BEP, we require mitigation techniques of more MAI. In this dissertation, we propose techniques to mitigate more MAI compared to conventional system in each of the three methods using error correction codes, MAI suppressing techniques and modulations. Chapter 1 describes the general introduction, the issue of MAI, and the conventional mitigation techniques of MAI in optical CDMA systems. Chapter 2 focuses on mitigation of MAI by using error correction codes and describes our proposed PPM symbol decision by threshold detection in Reed-Solomon coded optical pulse position modulation (PPM)-CDMA systems. If either more than two or zero correlator output exceeds the threshold level, the modulator decides the received PPM symbol as an erasure, which can increase the number of correctable symbols. We theoretically prove that the proposed scheme can achieve lower BEP than the conventional scheme using maximum-value detection. Chapter 3 focuses on mitigation of MAI by using MAI suppressing techniques and describes our proposed transmission scheme of optical pulses with two-level intensities for on-off keying (OOK)-CDMA system with double optical hard-limiters (OHLs). The OHL in each weighted position with high intensity level can easily eliminate MAI with low intensity, which can enhance the capacity for MAI suppression of OHLs. We theoretically prove that the proposed system can achieve lower BEP than the conventional system transmitting optical pulses with one-level intensity. Chapter 4 focuses on mitigation of MAI by using effective modulations and describes our proposed M-ary pulse-amplitude modulation (PAM) coded CDMA system applying the chip-level receiver with M-level threshold detection. The proposed system can obtain the synergistic effect that the chip-level receiver suppresses the large effect of MAI in the PAM-CDMA with the correlator and the PAM has larger number of bits per pulse than the OOK. We theoretically prove that the proposed system can achieve lower BEP than the conventional OOK-CDMA systems using the chip-level receiver. Chapter 5 focuses on mitigation of the large effect of MAI in Tunable Transmitter Fixed Receiver (TTFR)-based optical OOK-CDMA systems by using MAI suppressing techniques and describes our proposed additional second time-encoding scheme. The proposed scheme further encodes the first-encoded optical pulses by using the second code assigned to the transmitter, which can achieve higher code spreading gain than the conventional scheme without the second time-encoding. We theoretically prove that the proposed scheme can achieve lower BEP than the conventional scheme without the second time-encoding. Finally, Chapter 6 concludes this dissertation.		