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A study of Punctured Turbo Code with Unequal Transmission Power Allocation Technique in Optical Wireless Channel

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I INTRODUCTION

In recent years, turbo codes have gained attention as an effective error correction technique in Optical Wireless Communication(OWC)[1][3]. It has been clearified that the implementation of turbo code with Unequal Transmission Power Allocation(UTPA) technique in an OWC can lead to better BER performance[2]. However, arguably the performance of higher code-rate, punctured turbo codes with UTPA technique under OWC has not been assessed. In this paper, we consider a punctured turbo code with code rate $r = 1/2$ and allocation of different power on message bit and parity bit at encoder outputs with constant total transmission power. We simulate the system in OWC and verify the existence of optimal power allocation ratio in terms of average received optical power.

II SYSTEM MODEL

Figure 1 illustrates the system model of rate 1/2 punctured turbo code with UTPA. At the transmitter, combination of two parallel concatenated RSC(Recursive Systematic Convolutional) encoders and a N-bit random interleaver(π) encodes the source data. The even-odd bit puncturing algorithm discards one of the parity bit and only one parity bit is transmitted in order to improve the coding rate. The message and parity bit thus generated are allocated with appropriate transmission power. α and β is taken as power level allocated to the message bit(s) and parity bit(p) respectively. The power allocation ratio can be expressed as α/β. In the case of rate 1/2 turbo codes with puncturing algorithm, it can be assumed that $\alpha+\beta = 1$ ($\alpha \neq \beta$), to make the total transmission power fixed. The optical source dispatches the serial signal through the atmospheric propagation path. At the receiver, the received optical signal is converted into electrical signal by an avalanche photo detector(APD). Then the electrical signal is iteratively decoded by two MAP decoders. The final data is obtained by performing hard decision on the output of the second decoder.

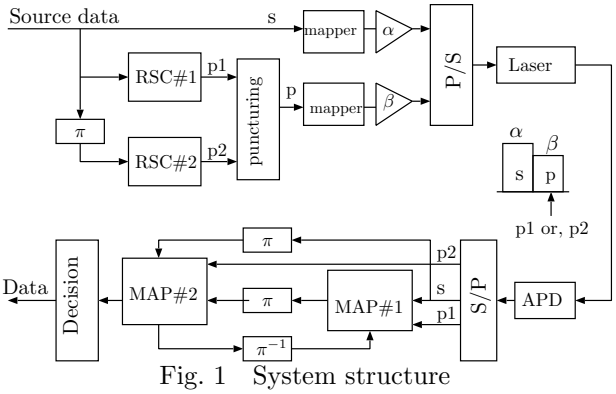

Fig. 1　System structure

III SIMULATION RESULT

Figure 2 shows the BER performance as a function of the transmission power allocation ratio for the rate 1/2 turbo code. α/β is set in the range 0.8 and 1.6, where 1.0(i.e $\alpha = \beta$) is a typical value. The interleaver consists of 256×256 matrix(N=256 bits) and the number of decoding iterations is set to 10. From the graph, it can be confirmed that the optimal α/β is 1.3 when the average received optical power per bit(Pw) is -51.8[dBm]. Better performance is attained when α/β is greater than 1. It implies the effectiveness of rate 1/2 turbo code with UTPA in OWC.

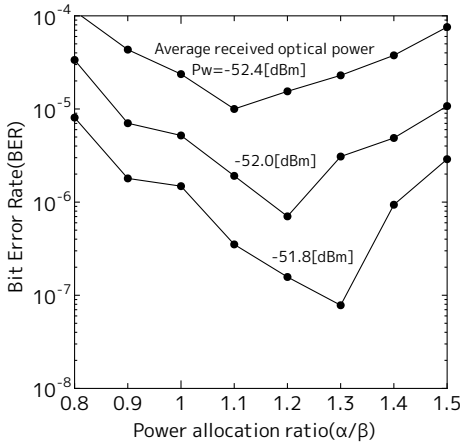

Fig. 2　BER vs transmission power allocation ratio

IV CONCLUSION

The result of this study suggests that considerable performance improvement can be achieved by applying UTPA technique in rate 1/2 punctured turbo code under optical wireless channel. The optimal transmission power allocation ratio at 1.3 suggests that it is better to increase the power of the message bit so as to reap the benefit of UTPA technique.

ACKNOWLEDGEMENT

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