



Performance of CSK Modulation with Various Lengths

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Contents



1. Introduction
2. CSK modulation applied GNSS signal
3. Simulation result and conclusion



Introduction



- Recently, as the use of the global navigation satellite system (GNSS) increases, various services other than simple positioning services are appearing in the civilian and military fields
- Therefore, the demand for data transmission is also increasing, which is the same as the demand for increasing the data rate of the navigation satellite
- The satellite navigation system uses the direct sequence spread spectrum (DSSS) with long PRN code (mostly, 5115 or 10230 chips)



Introduction



- To increase the data rate in a limited band, a code-shift keying (CSK) modulation method has been proposed
- It is possible to increase the data rate in a limited band while maintaining the orthogonality of the PRN code
- In the case of Japan's QZSS LEX signal, which is the first satellite signal to which CSK modulation has been applied



Introduction



- In this paper, we briefly introduce the CSK modulation method used in GNSS signals, the corresponding transmitter/receiver, and the method of calculating hard/soft decision values
- In the end of the paper, we conclude by showing the experimental results and analysis

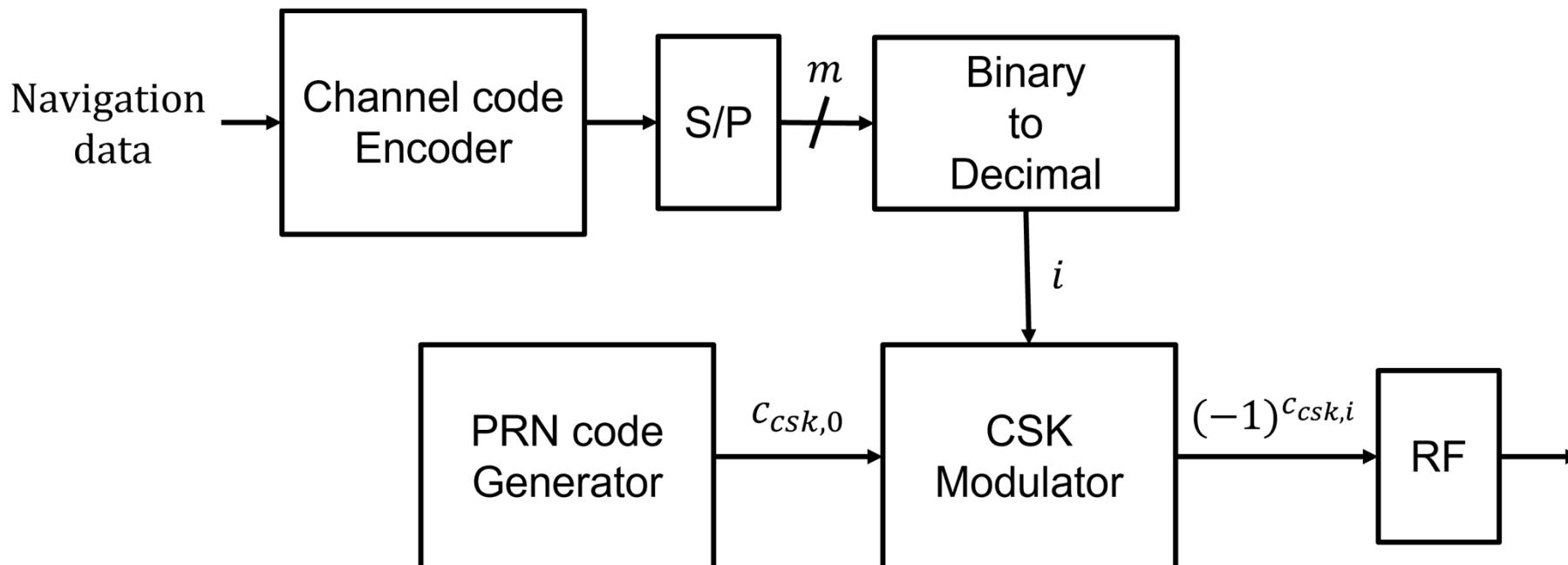


Fig. 1. A transmitter of GNSS signal with CSK modulation applied

1. A navigation messages pass through a channel encoder to generate a codeword, and
2. The generated codeword is converted into a one symbol by m bits

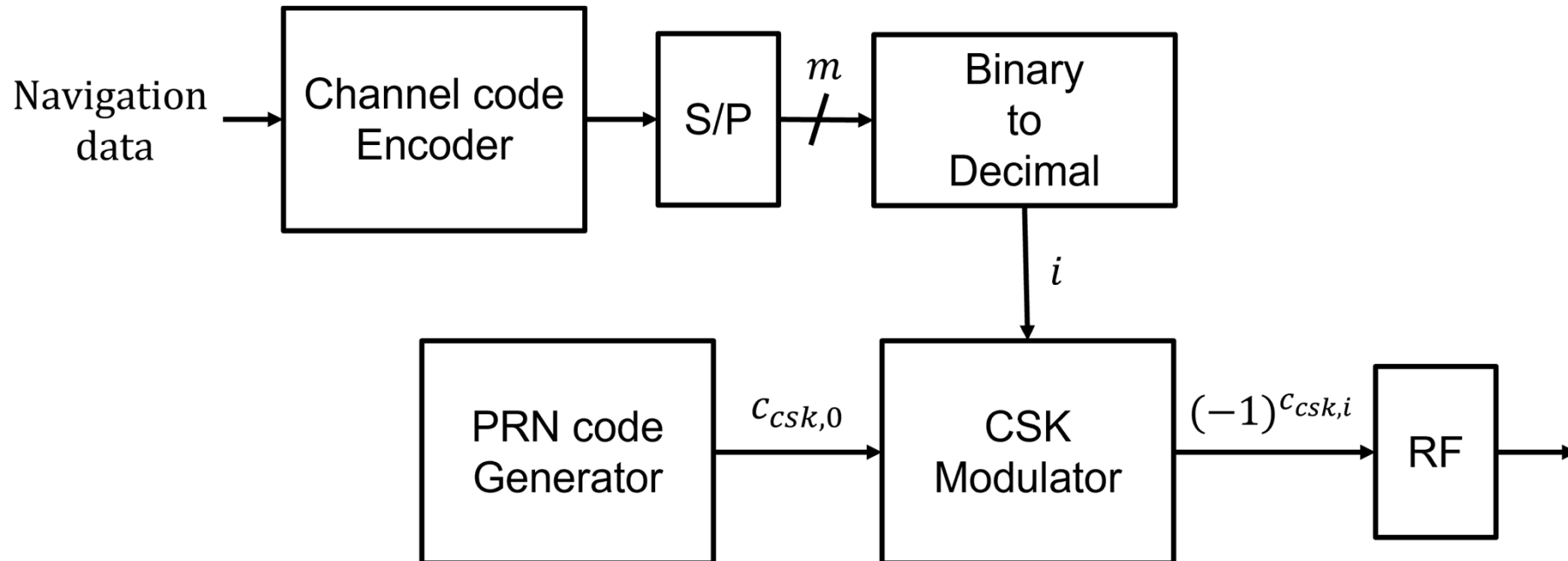


Fig. 1. A transmitter of GNSS signal with CSK modulation applied

3. A PRN code having a length L is cyclically shifted by the decimal value $0 \leq i \leq M(= 2^m - 1)$ of the symbol and transmitted

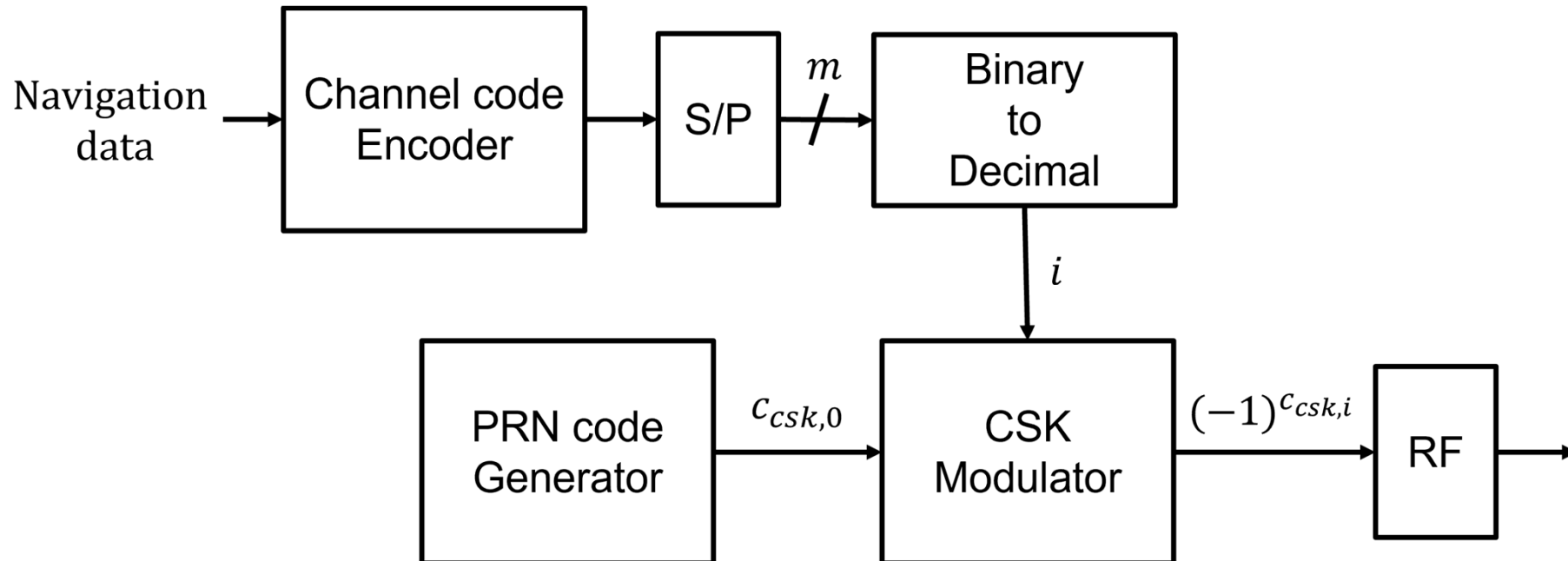
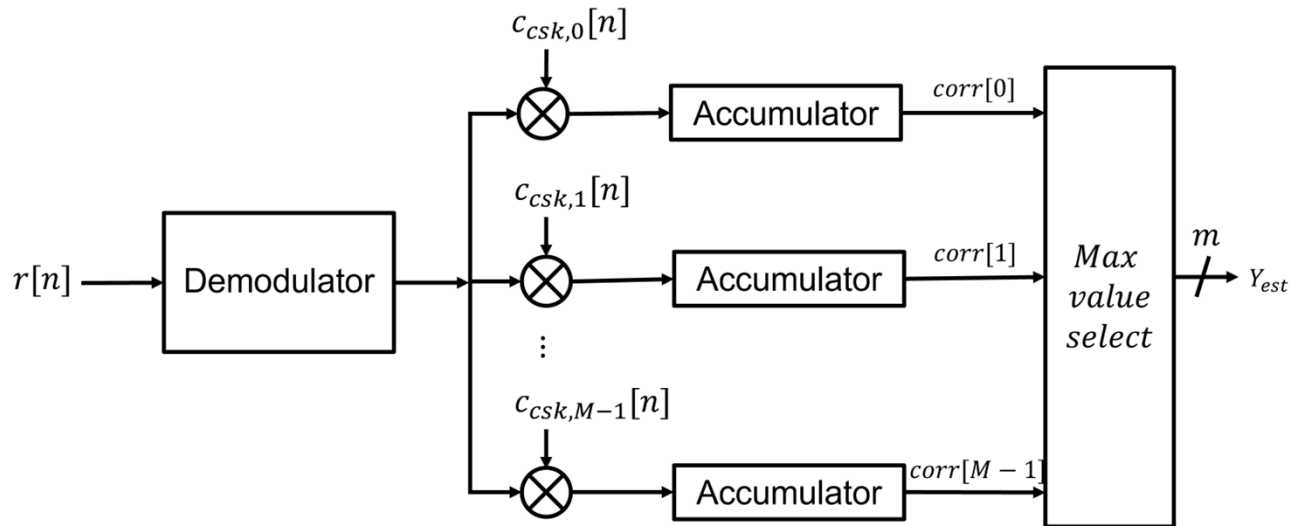
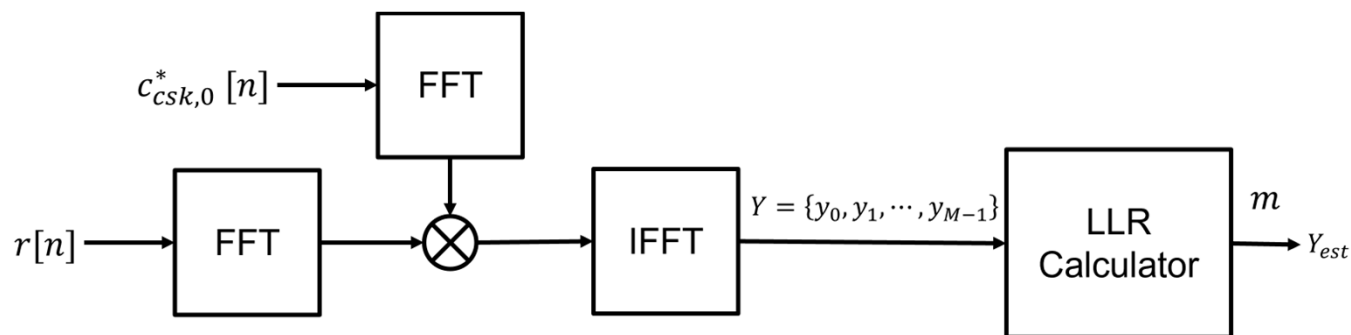


Fig. 1. A transmitter of GNSS signal with CSK modulation applied

4. At this time, $c_{csk,i}$ is a PRN code cyclically shifted by i



(a) Hard decision demodulator [5]



(b) Soft decision demodulator [6,7]

Fig. 2. A demodulator of GNSS signal with CSK modulation applied

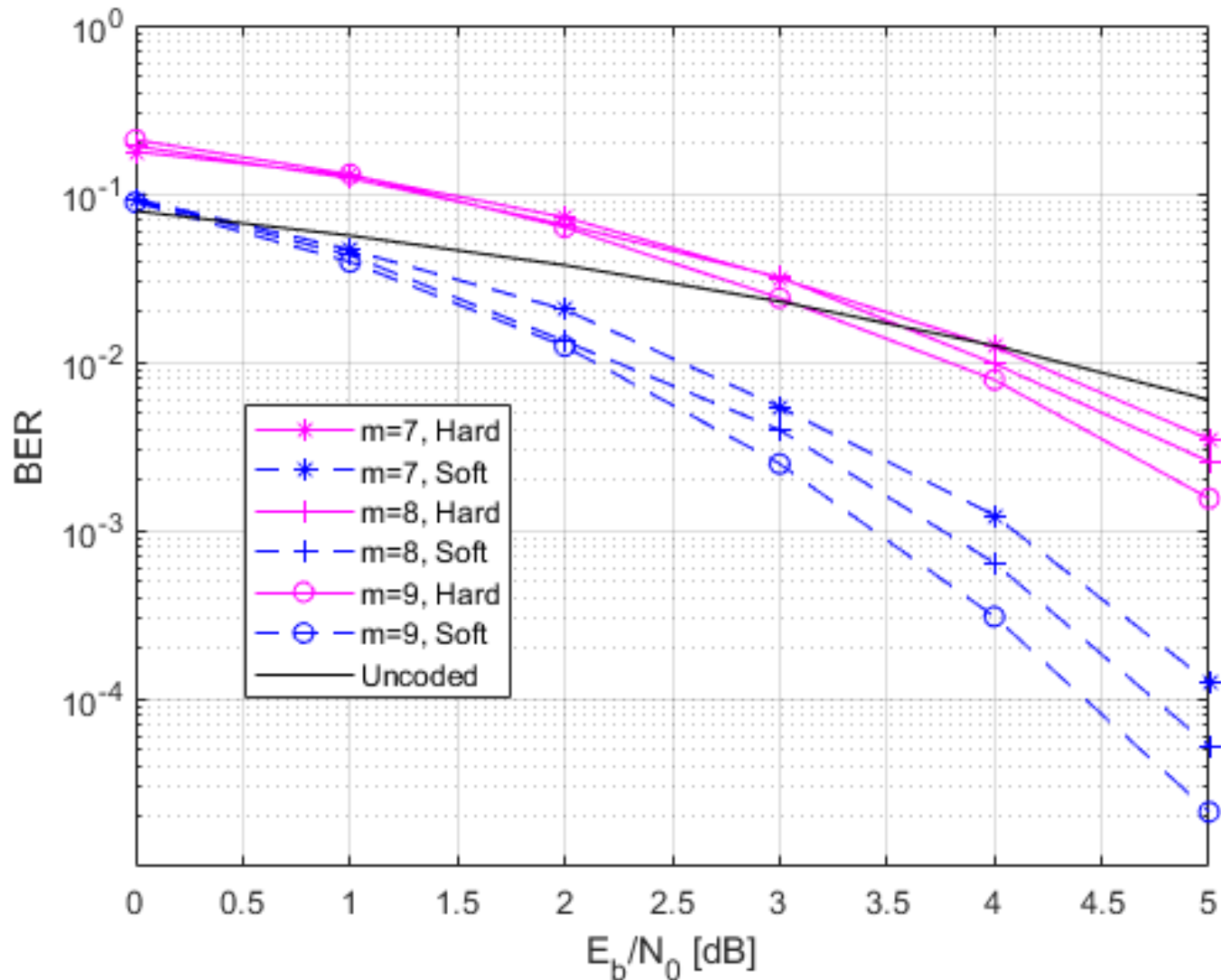


Fig. 3. The CSK modulation performance ($m = 7, 8, 9, L = 10230$)

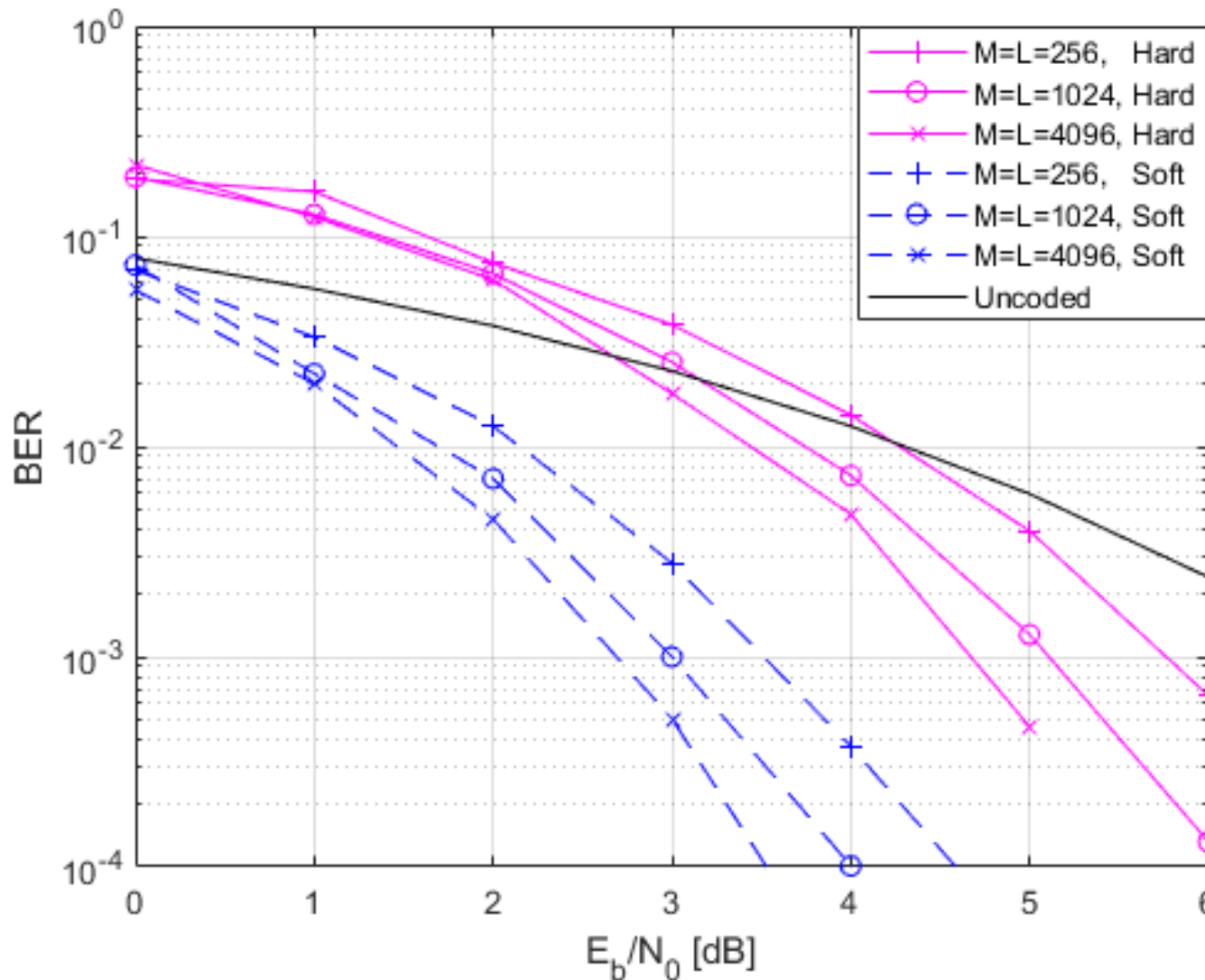


Fig. 4. The CSK modulation performance ($L = M = 2^m, m = 8, 10, 12$)



SIMULATION RESULT AND CONCLUSION



- According to [8], it was confirmed that the longer the value of m , the better the performance
- In the future, it is necessary to compare C/N_0 , which is the FoM from the viewpoint of the receiver
- In addition, we want to analyze the performance combined with channel coding



Thank you !!