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FOUR DIMENSIONAL CODED MODULATION WITH GMI FOR FUTURE OPTICAL COMMUNICATION

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***Abstract*--The coherent optical CM transceivers where the receivers is based on a Genaralized Mutual Information structure.Coded modulation is the combination of forward error correction and multilevel constellations.Coherent optical communication systems result in a four-dimensional signal space, which naturally leads to 4D-CM transceivers. The constellations that transmit and receive information in each polarization and quadrature independently is best 4D constelaion designed for uncoded transmission.Theoretical gains are as high as 4D constellations designed for uncoded transmission. Theoretical gains are as high as 4 db ,which are validated via numerical simulations of low density parity check codes. The GMI is the correct metric to study the performance of capacity approaching CM transceivers.GMI is useful in practiacal life for the communication purpose. By GMI the transferred bits reach the receiver part without any losses in data and also if we use GMI the efficiency would be more and also BER is reduced to greater extent**

***Index Terms* –*Bit interleaved coded modulation, Bit wise decoders, Channel capacity, Coded modulation, Fiber optic communications, Low density parity check codes, Non linear distortion*.**

I. INTRODUCTION

Incoherent fiber optic communication systems, both quadratures and both polarizations of the electromagnetic field are used. This naturally results in a four-dimensional (4D) signal space. To meet the demands for spectral efficiency, multiple bits should be encapsulated in each constellation symbol, resulting in multilevel 4D constellations. To combat the decreased sensitivity caused by multilevel modulation, forward error correction is used. The combination of FEC and multilevel constellations is known as coded modulation. The most popular modulation [1] multilevel coding and bit interleaved coded modulation [3]-[5].

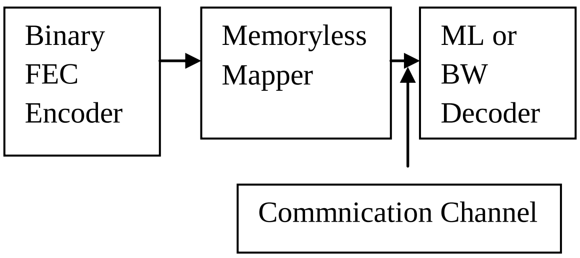

Fig .1 CM Encoder and Decoder

II. RELATED WORKS

A coding technique is described which improves error performance of synchronous data links without sacrificing data rate or requiring more bandwidth. This is achieved by channel coding with expanded sets of multilevel/phase signals in a manner which increases free Euclidean distance. Soft maximum likelihood[11] decoding using the Viterbi algorithm is assumed. Following a discussion of channel capacity, simple hand-designed trellis codes are presented for 8 phase shift keying and 16 quadrature amplitude shift keying modulation.

The simple codes achieve coding gains in the order of 3-4 dB. It is then shown that the codes can be interpreted as binary convolutional codes with a mapping of coded bits into channel signals, which we call "mapping by set partitioning." Based on a new distance measure between binary code sequences which efficiently lower bounds the Euclidean distance between the corresponding channel signal sequences, a search procedure for more The use of trellis coded modulation[12]-[14] in combination with an outer block code is considered for next generation 100 Gb/s optical transmission systems. When the concatenated code based on the two interleaved BCH codes is used as the outer code, the NCG is 9.7 dB.

The impact of quantization on the performance of the concatenated TCM scheme with the two interleaved BCH [15] outer codes is evaluated, and it is shown that 4-bit quantization is sufficient to approach the “infinite precision” performance to within 0.15 dB.

Performance assessment of MIMO BICM demodulators based on mutual information. In this paper Codes evaluated for PDM QPSK 100 Gb/s optical systems are generally designed for binary input binary output. Such systems typically employ a hard decision decoder. It is well known that soft decision decoding has the potential to improve the performance over hard decision decoding [16] when the forward error correction overhead is sufficiently high. For binary transmission FEC coding requires raising the some processing of Symbol rate and thus increasing the transmitted signal bandwidth. The use of trellis coded modulation as a technique to combine coding and modulation has been considered in different forms. To achieve better performance, bit interleaved coded modulation schemes[17] based on binary low density parity check component codes have been proposed.

However, due to the high implementation complexity of the soft iterative decoding process of LDPC codes at speeds of 100 Gb/s, only component codes of moderate length are considered. This introduces a non negligible loss in term of net coding gain NCG at the bit error rate of interest for optical transmission systems. In this letter, we consider the use of TCM [18] as the inner code in as concatenated coding scheme.

A soft decision inner decoder and a hard decision outer decoder are employed, thus allowing for a reasonable implementation complexity. Two block codes specified in ITUT recommendation [19] are used as an outer code. The effect of quantization of the in phase and quadrature components of the received signal samples after optical electronic conversion is investigated.

Application of multi level coded modulation for 16 a constellations in coherent systems is studied. An MLCM system with Reed Solomon component codes and multi stage decoder is considered. A systematic numerical method for finding set partitioning and optimal code rates is presented.

Results of numerical simulations and experiments supporting this statement are presented. For the cost efficient hardware implementation of bandwidth variable transceivers supporting several polarization multiplexed and four dimensional modulation formats, digital signal processing algorithms are required which

operate format transparent and consume little hardware resources. We discuss data aided signal processing as one possible option, in particular with respect to carrier frequency recovery and channel estimation in combination with frequency domain equalization.

The generalized mutual information is an achievable rate for bit interleaved coded modulation and is highly dependent on the binary labeling of the constellation [20]. The BICM-GMI, sometimes called the BICM capacity, can be evaluated numerically. This approach, however, becomes impractical when the number of constellation points and the constellation dimensionality grows, or when many different labelings are considered.

We focus on recent advances in four dimensional modulation formats and in modulation format transparent data aided digital signal processing. It is argued that four dimensional modulation formats present an attractive complement to conventional polarization multiplexed formats in the context of bandwidth variable transceivers, where they enable a smooth transition with respect to spectral efficiency while requiring marginal additional hardware effort. The cost efficient hardware implementation of bandwidth variable transceivers supporting several polarization multiplexed and four dimensional modulation formats, digital signal processing algorithms are required which operate format transparent and consume little hardware resources.

III. OUR PROPOSED FRAME WORK

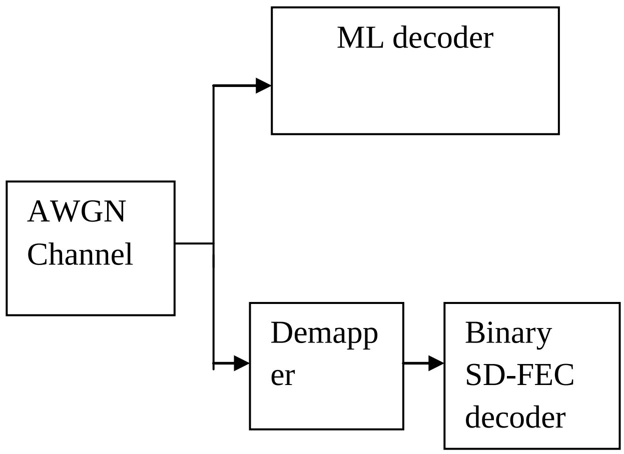

Fig.2 Post FEC Decoder block diagram

A generic bit interleaved coded modulation systems with an approximate demodulator or log likelihood ratio computer. Caireetal. in terms of the capacity of an independent parallel channel model with binary inputs and continuous LLR [5] as outputs, and by Martinezetal.

In terms of the generalized mutual information GMI where the BICM decoder is viewed as a mismatched decoder.GMI and capacity of the parallel channel model coincide under optimal demodulation, they differ in general for the case of an approximate demodulator. Multidimensional constellations optimized for uncoded systems were shown to give high MI and are thus good for ML decoders bits reach the receiver. By GMI the transferred part without any losses in data and also if we use GMI the efficiency would be more and also BER is reduced.

In Probability theory and information theory, the mutual information or formerly trans information of two random variables is a measure of the variables mutual dependence.. MI is the expected value of the point wise mutual information. The most common unit of measurement of mutual information is the bit.

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A simple approximation for the BICM GMI based on the area theorem of the demapper's extrinsic information transfer function is proposed. Numerical results show the proposed approximation gives good estimates of the BICM GMI for labelings with close to linear EXIT functions, which includes labelings of common interest, such as the natural binary code, binary reflected Gray code, etc.

This approximation is used to optimize the binary labeling of the 32 APSK constellation defined in the S2 standard. Gains of approximately 0.15 Db are obtained.

Four dimensional modulation formats present an attractive complement to conventional polarization multiplexed formats in the context of bandwidth variable transceivers, where they enable a smooth transition with respect to spectral efficiency while requiring marginal additional hardware effort. Results of numerical simulations and experiments supporting this statement are presented. Bandwidth variable transceivers enable the software controlled adaptation of physical layer parameters such as transmitted bit rate, spectral efficiency and transparent reach according to the traffic demands at hand. In particular, we focus on recent advances in four dimensional modulation formats and in modulation format transparent.

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IV. PREFORMANCE EVALUATION

The number of bits per dimension is an integer, due to their practical relevance. The examples studied have 1, 2, and 3 bits/dimension, which corresponds to, respectively, 4, 8, and 12 bits/symbol or M = 16, 256, and 4096 constellation points.The simulation result shown in fig 3.1,fig 3.2 is from our base paper and We have discussed to improve our SNR and BER which is under survey.

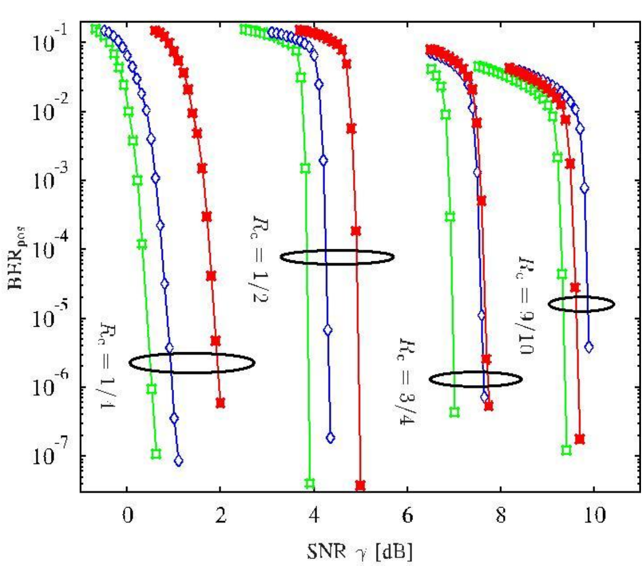
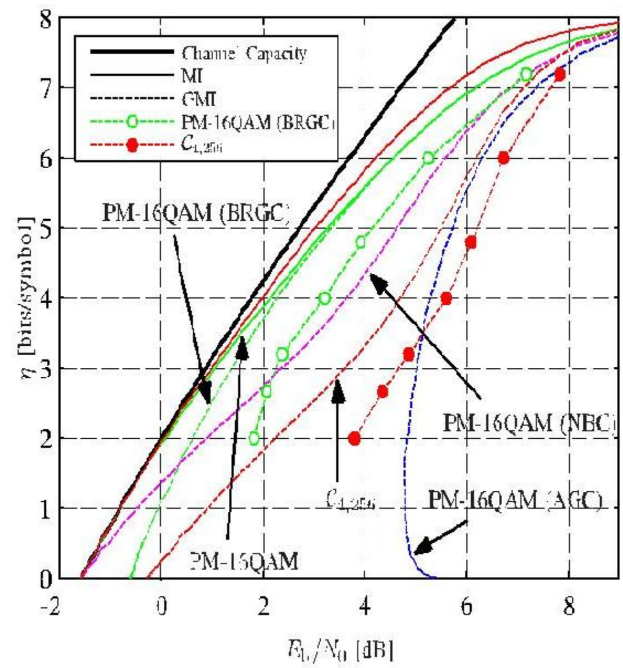


Fig .3.1



V. CONCLUSION

The achievable rates for coherent optical CM transceivers where the receiver is based on BW decoder. Multidimensional constellations optimized for uncoded systems to give high MI and ML decoders. These constellations are not well suited for BW decoders . It was shown that GMI is correct metric to study the performance of capacity approaching CM transreceivers. Due to that BER and SNR increase to create an extent.

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