International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-4 Issue-1, October 2014

A Message-Fleeting Receiver for BICM-OFDM over Anonymous Crowded - Meagre Channels

M. Ashok Kumar, T. Aditya Kumar

Abstract: In disparity to surviving designs, ours is proficient of manipulating not onlymeagrely in sampled channel taps but also crowding among the bulky taps, performances which are notorious to evident at larger communication bandwidths. We intend a factor-graph-based tactic to united channel - approximation and decrypting of bit-interleaved coded orthogonal frequency division multiplexing (BICM-OFDM). In order to exploit these channel-tap structures, we espouse a two-state Gaussian mixture prior in conjunction with a Markov model on the concealed state. For impractical credence promulgation, we exploit a "generalized approximate message passing" algorithm recently developed in the context of compressed sensing, and show that it can be successfully coupled with soft-input soft-output decrypting, as well as hidden Markov inference. For N subcarriers and M bits per subcarrier (and any channel length L < N), our scheme has a computational complexity of only O (N log2 N+N2M). Statistical trials using IEEE 802.15.4a channels show that our scheme yields BER performance within 1 dB of the known-channel bound and 5 dB better than decoupled channel-estimation-and-decoding via LASSO..

Keywords: OFDM, LASSO, Markov inference

I. INTRODUCTION

Wireless communication services tend towards "anywhere" and "everywhere" capabilities. Most of the available services require a stationary base station (BS) to provide links between mobile stations (MS). There is a growing research interest for wideband MTM communications that might allow future digital broadband mobile services with a reduced infrastructure investment. Dedicated broadband communications to vehicles could open the doors for either the transformation of industries such as broadcasting or the creation of new services. There is also a growing interest from the military in wideband mobile-to-mobile communications for tactical applications such as the handheld multimedia terminal (HMT) developed for the Defense Advanced Research Projects Agency (DARPA), which is based on the development of the Tactical Internet, a data channel also used for routing information to identify positions of friendly forces [90]. Another one of these conceived services is DSRC, which is a short to medium range service that supports both Public Safety and Private operations in roadside-to-vehicle and vehicle-to-vehicle communication environments.

Manuscript published on 30 October 2014.
***** Correspondence Author (s)
M. Ashok Kumar, M.Tech Student, Park College of Engineering And Technology, Kaniyur, Tamil Nadu, India.
T. Aditya Kumar, Assoc. Prof., Park College of Engineering and Technology, Kaniyur, Tamil Nadu, India.

Many papers on vehicle-to-vehicle channel characterization address a "platooning"application, which enables vehicles to travel at high speeds in close proximity. In a platoon, the typical channel is a line-of-sight (LOS) signal path over relatively small transmitter-receiver separations ranging from 1 m to 40 m [41], [84]. These channels usually exhibit small delay spreads, *e.g.*, RMS delay spreads less than 40 nS [22], [25]. In contrast, for an emergency-notification application, transmitter-receiver separations may be significantly larger than within a platoon, and vehicles, buildings or other structures may block the LOS path. These conditions may lead to larger delay spreads, as suggested by fixed-to-mobile urban measurements [44]. In that work, with antenna heights as low as 1.6 m, delay spreads were reported to increase with transmitter-receiver separation. Delay spreads were also observed to increase when the LOS path was blocked [44]. These factors motivated us to try to find sites in Atlanta, Georgia that exhibit large delay spreads since we consider that such sites will provide the most challenging environments for MTM communications.

II. BACKGROUND

A major prerequisite for the design of future wideband digital mobile radio (WDMR) systems or the optimization and extension of existing WDMR systems is a thorough knowledge of the propagation characteristics of themobile radio channel. Because of the complexity of the propagation phenomena and because of the statistical nature of the radio channel parameters, a reliable channel characterization can be based only on appropriate channel measurements. In this chapter, we present an overview of the channel modeling fundamentals and an overall look at the available channel sounding techniques. We also offer a general description of the existing techniques to combat synchronization problems in OFDM.

III. BICM-OFDM MODEL

We consider an OFDM system with N subcarriers, each modulated by a QAM symbol from a 2M-ary unit-energy constellation S. Of the N subcarriers, Np are dedicated as pilots, and the remaining Nd , N − Np are used to transmit a total of Mt training bits and Md , NdM− Mt coded/interleaved data bits. The data bits are generated by encoding Mi information bits using a rate-R coder, interleaving them, and partitioning the resulting Mc, Mi/R bits among an integer number Q, Mc/Md of OFDM symbols. We note that the resulting scheme has a spectral efficiency of η, MdR/N information bits per channel use (bpcu).

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

In wireless communication systems, signals that are sub ject to deep fading are very difficult to recover. If only one channel is resp onsible for reliable transmission, under the most common channel mo dels the average error probability decays slowly, typically like 1 /SNR where SNR is the *average* signal-to-noise ratio. On the other hand, when multiple (and, ideally, independent) channels are used, the probability that they are all in deep fades is significantly reduced. This gives inspiration to *diversity* techniques which improve the performance of detection over fading channels. The philosophy of various diversity techniques is essentially the same: the receiver is provided with multiple "replicas" of the same information; the received signals containing this information experience different (and again, ideally, independent) channel gains, have different coding structures, etc. If they are combined appropriately, channel fading may be mitigated. Commonly used diversity techniques include transmission through multiple carriers (frequency diversity), time slots (time diversity), or antennas (spatial diversity); other techniques have also been considered in practice but not widely used, such as angle-of-arrival diversity and polarization diversity. The key feature of BICM is that, at the transmitter, a bit interleaver is introduced between a binary channel encoder and the modulator. In this way, coding and modulation are separated. Compared with TCM, the disadvantage of this is obvious: the free Euclidean distance is not explicitly maximized, so the resulting. LDPC co des are well known for their capacity-approaching p erformance. An LDPC co de is a linear blo ck co de characterized by a sparse parity-check matrix. Two main deco ding algorithms are (1) the bit flipping algorithm, which executes hard-decision deco ding and has low complexity, and (2) the message passing/b elief propagation/sum-pro duct algorithm, which executes iterative soft-decision deco ding and has higher complexity. The excellent p erformance of LDPC co des generally comes from the latter, and approximations can b e made to reduce complexity at acceptable cost of deco ding performance, especially when the SNR is relatively high. It should be emphasized that the focus of our work is not to optimize certain types of codes under the cooperative communication scenarios, but rather to exploit methods of utilizing *known* data to increase the probability of diversity and provide higher coding gain. When a partner node decodes, the known data refers to the relayed data that originated from this node and helps to increase the probability of cooperation to overcome the cooperative dilemma; when the destination decodes, the known data refers to the previous/future reliable decoding results and helps to improve the future decoding performance/correct the previous decoding failure.

IV. CONCEPT

At the start of the first turbo iteration, there is total uncertainty about the information bits, so that Pr{bm =1}= 12. Thus, the initial bit beliefs flowing rightward out of the coding/interleaving block are uniformly distributed. Meanwhile, the pilot/training bits are known with certainty, and thus take Pr{bm =1}∈{0, 1}. Messages are passed leftward into the coding/interleaving block. Doing so is equivalent to feeding extrinsic soft bit estimates to a soft-input/soft-output (SISO) decoder/deinterleaver, which treats them as priors. Since SISO decoding is a well-studied topic, we will not give details here. It suffices to say that, once the extrinsic outputs of the SISO decoder have been computed, they are reinterleaved and passed rightward from the coding/interleaving block to begin another turbo iteration. Our goal is to infer the information bits b from the OFDM observations y and the pilot/training bits cpt, without knowing the channel state x. In particular, we aim to maximize the posterior pmf p(bm | y, cpt) of each info bit. To exploit prior knowledge that x is clustered-sparse. where the round nodes represent random variables and the square nodes represent the probabilistic relationships between them.

V. OUTPUTS

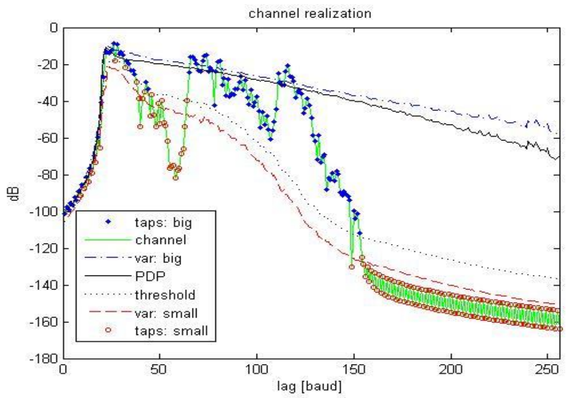

Fig. 1 Channel Realization

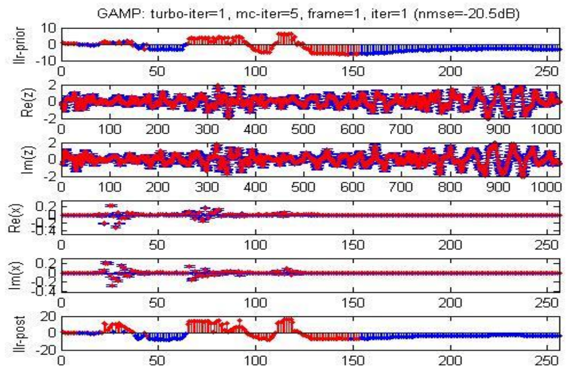

Fig. 2 GAMP Turbo

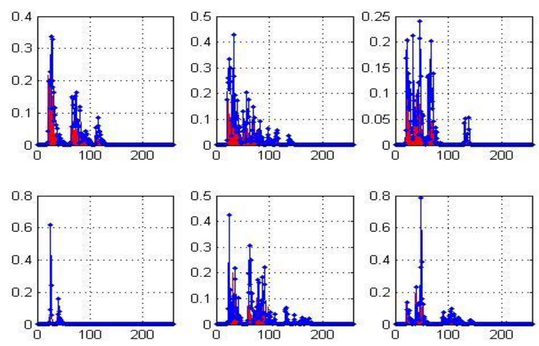

Fig. 3 Histogram Realizations

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

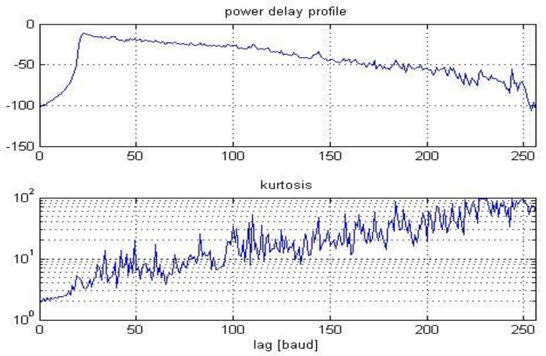

Fig. 4 Power Delay Profile

VI. CONCLUSION

We summarize the most important aspects and results of our work, present some conclusions, and provide suggestions for further research. In this thesis, we used the factor graph framework to design (possibly iterative) receiver algorithms. We first considered an IDMA system, derived a factor graph representation for it and used the factor graph to design a receiver performing joint data detection and channel estimation. Numerical results show that the proposed receiver operates close to the information theoretic limit and that joint data detection and channel estimation yields a dramatic performance gain. We next considered BICM systems, where the demodulator calculates quantized LLRs. Using the information theoretic concept of the equivalent BICM modulation channel, we designed an optimal quantizer and also proposed a new quantization scheme, which is easier to design. We propose a factor-graph-based approach to joint channel-estimationand-decoding of bit-interleaved coded orthogonal frequency division multiplexing (BICM-OFDM). In contrast to existing designs, ours is capable of exploiting not only sparsity in sampled channel taps but also clustering among the large taps, behaviors which are known to manifest at larger communication bandwidths. In order to exploit these channel-tap structures, we adopt a two-state Gaussian mixture prior inconjunction with a Markov model on the hidden state. For loopy belief propagation, we exploit a "generalized approximate message passing" algorithm recently developed in the context of compressed sensing, and show that it can be successfully coupled with soft-input soft-output decoding, as well as hidden Markov inference. We presented semi-analytical and numerical results, which show that only a few bits for LLR representation are needed. We also proposed an on-the-fly design of the quantizer parameters, thereby avoiding large lookup tables for storing the quantization parameters. Although $Np > 0$ pilot subcarriers are required for DCED channel estimation, JCED can function with $Np = 0$ as long as $Mt > 0$ interspersed training bits are used. To examine the latter case, shows BER versus Mt at Eb/No =10 dB, a fixed spectral efficiency of $\eta = 2$ bpcu, and $Np = 0$. There we see that there is a relatively wide tolerance on Mt , although the value $Mt \approx 450$ appears best when convergence speed is taken into account. Moreover, we can see a small but noticeable BER improvement when the MC block is used.Finally, we focused on BICM systems with imperfect CSI at the receiver. W e proposed optimal demodulator algorithms which take channel estimation errors into account, thereby offering improved performance. The improved demodulators can also be obtained by implementing the sum-product algorithm on the system's factor graph, thereby demonstrating the wide applicability of the factor graph approach. We demonstrated the performance gains possible with the proposed demodulators and also investigated the impact of allocation of pilot and data symbol power.

REFERENCES

[1] A. Nostrania, T. E. Hunter, and A. Hedayat, "Cooperative Communication in Wireless Networks," *IEEE Communications Magazine*, Vol. 42, pp. 74-80, October 2004.

[2] A. Stefanov and E. Erkip, "Cooperative coding for wireless networks," *IEEE Transactions on Communications*, Vol. 52, pp. 1470-1476, September 2004.

[3] G. J. Bradford, "A Framework for Implementation and Evaluation of Cooperative Diversity in Software-Defined Radio," Master's thesis, University of Notre Dame, Notre Dame, IN, December 2008.

[4] A. Sendonaris, E. Erkip, and B. Aazhang, "User Cooperation Diversity— Part II: Implementation Aspects and Performance Analysis," *IEEE Transactions on Communications*, Vol. 51, pp. 1939-1948, November 2003.

[5] E. G. Larsson and B. R. Vojcic, "Cooperative transmit diversity based on superposition modulation," *IEEE Communications Letters*, Vol. 9, pp. 778-780, September 2005.

[6] S. V. Maiya and T. E. Fuja, "Cooperative Communications Based on Trellis Pruning," in *Proc. IEEE ISIT*, Austin, Texas, U.S., pp. 933-937, June 2010.

[7] O. Collins and M. Hizlan, "Determinate State Convolutional Codes," *IEEE Transactions on Communications*, Vol. 41, No. 12, December 1993.

[8] G. Caire, G. Taricco and E. Biglieri, "Bit-Interleaved Coded Modulation," *IEEE Transactions on Information Theory*, Vol. 44, pp. 927-946, May 1998

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)