High Performance and Low Complexity Equalization Techniques by Multi-H CPM

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Abstract
Continuous phase modulations (CPM) represent a family of non-linear coded modulation schemes characterize by a constant envelope and continuity of the phase. The constant envelopes permit the use of very efficient non-linear power amplifiers in the transmitter, while level phase variations result in a compact spectrum. These modulations are classified as single-h CPM schemes and have been used in a variety of standards, such as GSM, Bluetooth etc. Frequency-domain equalization offers low-complexity, as compared to both the best greatest chances sequence detection and the time-domain equalizer, for a channel with large delay spread. The objective of our explore is to expand FDE techniques for multi-h CPM waveforms. Two FDE receiver architectures are planned for multi-h CPM; one that uses a MF front end and the other that uses a single low-pass filter follow by a sampler For both schemes, show that the sampled output of the receiver filter(s) satisfies a circulate matrix model for general mulit-h CPM waveforms given that the transmitted signal is cyclic for the duration of the block. Similarly, convolution drop can be obtained for variety based (SF-based) approach by truncate the auto-correlation matrix of the multi-h CPM signal. Imitation results are presented for the IRIG-106 Tier-2 dual-h CPM waveform.

1. Introduction

Continuous phase modulation (CPM) represents a family of non-linear coded modulation schemes characterized by a constant envelope and continuity of the phase. The constant envelope permits the use of very efficient non-linear power amplifiers in the source, while smooth phase variation counter in a compact spectrum. Typical CPM schemes use a single modulation index that controls the sensitivity of phase with respect to the foundation cipher. These modulations are secret as single-h

CPM schemes and have been used in a variety of standards, such as GSM, Bluetooth etc. An alternative of CPM, called multi-h CPM, has a set of modulation indices, and the modulator selects one from the set, in a round-robin way, in successive symbol intervals. The use of multiple modulation indices introduces asymmetries in the demodulating trellis of multi-h CPM signal, which delays the first merge, thereby increasing the coding gain relative to single-h CPM. Multi-h CPM has been used for voice-over-satellite communications, and has been included as the most sophisticated modulation scheme in IRIG -106 aeronautical telemetry standard. Aeronautical telemetry is witnessing a data deluge similar to other applications of wireless connections. Modern aeronautical devices host a rising number of sensors, which can broadcast flight testing data to the earth station. However, this excess data transfer requires more bandwidth making the behavior of the aeronautical channel increasingly selective in the frequency domain. The effect of the frequency-selective channel in the time domain is to introduce interference among the neighboring symbols called inter symbol interference (ISI).

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To get acceptable performance, this effect has to be mitigated/equalized at the receiver, prior to demodulation, by using an equalizer. Frequency-domain equalization (FDE) is a single-carrier technique that has low-complexity, as compared to both the optimal maximum-likelihood sequence detection (MLSD) and the time-domain equalizer, for a channel with large delay spread. Our objective is to develop a comprehensive framework to enable frequency-domain equalization (FDE) of multi-h continuous phase modulation (CPM). A reduced complexity receiver design for AWGN channels has been proposed for multi-h CPM using similar principles as Kaleh's receiver except that it uses a dynamic MF bank – the conventional signal is interrelated with the current set of Laurent pulses. As mention earlier, equalization is required at the receiver for signals transmitted over frequency-selective channel. There are two hurdles in designing a sensible frequency-domain equalizer for multi-h CPM; the requirement of a cyclic transmitted signal for the scope of the chunk and the exorbitant complexity of the receiver. The difficulty of construct a cyclic signal by using a cyclic prefix and an intrafix. The use of FDE itself reduces the difficulty of the receiver as compared to the optimal MLSD sender, but it can still be too high for partial-response tone schemes. There are two basic approaches to an FDE-based receiver design proposed previously for single-h CPM suffering from ISI; one that has a MF bank front end and the other that utilizes a single low-pass filter followed by incomplete sampling. Both these architectures utilize Laurent decomposition, and it has been reported that they have similar recital at comparable receiver complexity.

2. Related Work

Low-Complexity Linear Frequency Domain Equalization for Continuous Phase Modulation, W. Thillo, IEEE transaction

Description

Presented a new high-performance, low-complexity proceeds to linear FDE of block based CPM systems. To support our theory first developed a new poly phase matrix model, valid for any block-based CPM scheme, according to the familiar structure. The main dissimilarity with respect to the SOA receiver is that alienated channel equalization on the one hand and CPM demodulation on the other. This enabled us to exploit the correlation properties of the CPM signal in the demodulator, after the channel equalizer. Calculating the MMSE equalizer required the inversion of a no diagonal matrix. This defeats the main objective of FDE, namely low-complexity equalization require only inversion of diagonal matrices in the incidence domain. Therefore, in order to restore the original advantage of FDE, shown that the CPM autocorrelation matrix can be approximated by a block slanting matrix. Finally, simulations confirmed that our MMSE complexity reduction technique can be applied for any modulation index without noticeable performance loss.

Simple Coherent Receivers for Partial Response Continuous Phase Modulation, W. K. Kaleh/IEEE journal

Description

Presented a new best Viterbi receiver for the binary partial response CPM with rational index is presented. A near best possible Viterbi receiver with low complexity is then deduced. A bound for its degradation of act with respect to the optimum receiver is calculated. Also, an MMSE optimum linear receiver is derived for the modulation index 0.5 and for all values of E, A plan method for the receiver filter is given. The MMSE and upper and lower bounds for the bit error probability are intended. Explicit expressions are given for all needed parameter. The indication GMSK is used as an illustration. By using a pulse amplitude modulation representation of the binary continuous phase modulation signals, expand a new optimum Viterbi sequence detector and a near optimum Viterbi receiver with low difficulty. Also, for the modulation directory 0.5 where a linear receiver can be used, a least mean-squared error linear receiver filter is resultant. Their presentation is analyzed. The Gaussian minimum shift keying signal (GMSK) is used for illustration.

Digital Phase Modulation, J. B. Anderson, T. Aulin, and C. Sundberg, IEEE Syst

Description

Presented the heavy force in today's wireless market is the rising demand for wireless multimedia and interactive Internet services. OFDM has been widely accepted as a viable solution for such high-speed broadband applications. In this article, have attempted to present a complete overview of a talented different solution, SC-FDE, which has been in the past shadowed by OFDM. Although the basic ideas at the back SC-FDE can be traced rear to Walzman and Schwartz's work on adaptive equalizers in 1973, the new surge of interest in SC-FDE was subsequent. SC-FDE enjoys a comparable complexity to OFDM due to the alike transceiver architecture based on efficient FFT/IFFT operations. Owing to the single-carrier completion, SCFDE also avoids the intrinsic drawbacks of OFDM such as amplifier nonlinearities, carrier rate offsets, and phase noise. OFDM is generally used in practice in combination with coding and/or adaptive modulation.

Exact and Approximate Construction of Digital Phase Modulations by Superposition of Amplitude Modulated Pulses (AMP),

P. Laurent, IEEE transaction,

Description

Presented The AMP disintegration of MSK-like modulations (h =0.5, any L) was already achieved a few years ago. Its form was somewhat different from the one presented here, because it unreservedly took into account the property of J = expj(r/2). Our sweeping statement to any no integer value of the modulation index was achieved soon after, with the help of a desktop workstation. AMP considerate of binary CPM is now in current use in our laboratories, owing to the significant simplifications it leads to: spectrum computations, intonation analysis bearing in mind only the important components, and conception of modulators and demodulators. New methods for computing autocorrelation and power frequency range are derived, which give very simple results for half-integer directory modulations. Also show that the indication can be built with good accuracy using only one optimized pulse ("major beat"). This mixture is particularly satisfactory for modulations that have good spectral individuality and/ or low directory.

DFSE Equalization of Dual-H CPM over UHF MILSATCOM Channels, B. W. Peterson,

D. R. Stephens, and W. H. Tranter/IEEE Comput,

Description

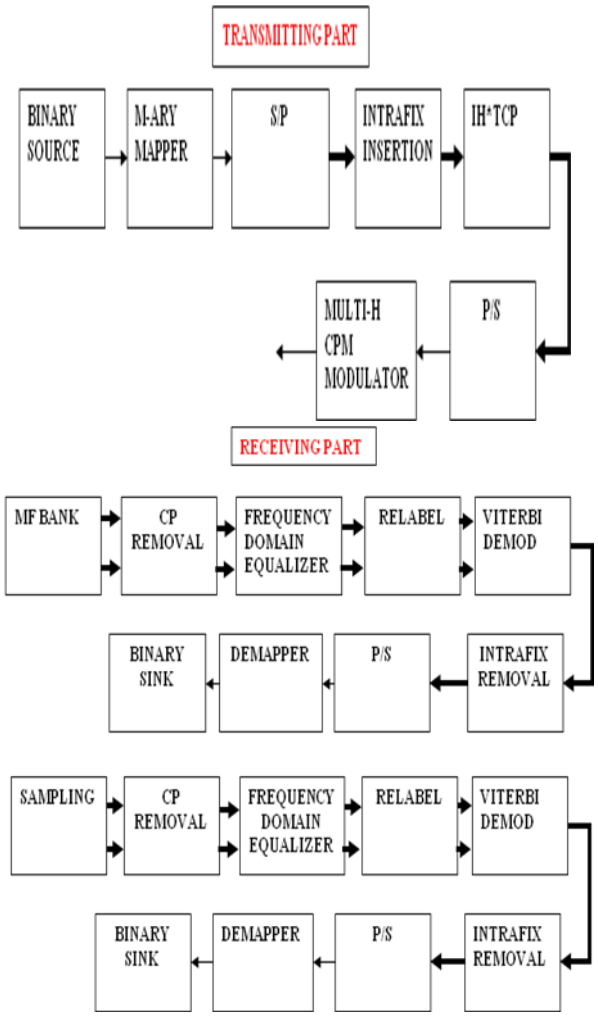
Presented Ultra High Frequency (UHF) military outpost transportation (MILSATCOM) relations provide narrowband tactical secure voice and data communications to the movable war fighter. The current satellite constellation, UHF Follow-on (UFO), uses four pair of collocated satellites spaced in quadrature about the equatorial plane parked in low-incline geostationary orbit. Each UFO satellite provides one Earth coverage beam and contains a warning repeater UHF transponder payload that provides only 21-5 kHz and 17-25 kHz "bent-pipe" guide. To support the rising demand for high data rate service, the joint Interoperability Engineering institute (JIEO) and Defense Information Systems Agency (DISA) introduce a quick dual-h CPM waveform that increased data rates to 56 kbps doubling current capacity without requiring increased transmitter power or bandwidth.

3. Proposed System

Continuous phase modulation (CPM) is a non-linear constant-envelope inflection scheme with memory, known for its bandwidth and power competence. Multi-h CPM uses multiple modulation index in consecutive symbol intervals to get better the error performance as compared to single-h CPM (basic CPM that utilizes only a single modulation index). One of the main applications of multi-h CPM is in aeronautical telemetry system. Aeronautical telemetry is witness an information deluge alike to other application of wireless message. Contemporary aeronautical devices hosts an increasing number of sensors, which be able to transmit

flight-test data to the earth station. However, this excess data transfer requires more bandwidth, making the behavior of the aeronautical channel more and more selective in the frequency domain. Various simplifications are proposed for each architecture, and the trade-off among receiver complexity and presentation is analyze and verified through detailed simulation studies. For presentation evaluation, think a dual-h CPM waveform (used in the IRIG-106 telemetry standard) affected by a wideband aeronautical telemetry guide model. Our theoretical results and proposed architectures for FDE of multi-h CPM will be a significant giving towards achieve fast and reliable aeronautical telemetry.

Block Diagram:



As mentioned in the previous chapter, the purpose of our research is the frequency domain equalization (FDE) of multi-h incessant phase intonation. Transport in constant phase modulation motivate the need for equalization in a frequency-selective channel, recognize the challenge concerned and the compensation gained by performing equalization in the frequency domain, and provide a short review of the existing transceiver technique for single-h and multi-h CPM in frequency-selective guide.

4. Conclusion

In this object, focused on rising low-complexity techniques for frequency-domain equalization (FDE) of multi-h continuous phase modulation (CPM). We recognized that there were two major hurdles to be cleared before reaching this ultimate goal. The first difficulty to be addressed was the requirement of the block format to make a cyclic transmitted multi-h CPM signal. To attain this reason, provided a detailed discussion on the structure of the spreader. The next subject was that of the design of the receiver, which includes the design of face end to make statistics, equalizer to alleviate meddling, and demodulator to notice symbols. Some solutions to these plan problems are proposed, compare, and evaluate.

5. Future Work

In the preceding section, we listed the major aid made in this conjecture, in the area of frequency-domain equalization intended for multi-h CPM. Because of the ever rising needs for data rates in all communication relations so to execute the QAM and PSK method.

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