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Method and Device for Coded Modulation

Introduction

A transmitter in a communication scheme converts digital information into a waveform that is sent to the receiver. The conversion comprises the encoding of the bits by an error-correcting code, and subsequently the mapping of the coded bits to complex symbols belonging to a constellation. The error rate performance of the transmission is fundamentally lower bounded by information theoretical limits. In the case of terrestrial communication in an area with reflectors (e.g. an urban area), fading is an omnipresent factor in the communication channel and there exists a fundamental lower bound on the word error rate or frame error rate which is the outage probability. Similar scenarios that are also applicable consist of multiple-antennae environments and cooperative communications. An optimal transmitter achieves this lower bound by selecting a suitable error-correcting code and constellation while keeping the computational complexity reasonably low.

A constellation is a multi-dimensional grid of symbols each having a bit label as identifier. The mapping of bits to symbols in a constellation consists of selecting the symbol in the constellation that has the label corresponding to a group of bits. The optimization of the constellation consists of optimizing its geometry and its labeling.

In prior art, the optimal geometry for these terrestrial channels was determined so that the outage probability was minimized. However, there was a need for selecting the best possible labeling and also the best possible error-correcting code for the context of terrestrial communication with reflections. This technology addresses this need.

Technology

The communication channel has multiple fading gains that span over the transmission of a frame. Our technology consists of selecting a limited number of extreme but well-chosen channel instances over which the transmitter parameters are optimized. By continuity, the overall average error rate performance over the channel is close-to-optimum. Methods are given both for constellation design as error-correcting code design.

Applications

Communication over slow fading channels (typically in communication environments with many reflectors, such as urban environments), using diversity techniques (multiple antennae, time-interleaving, or frequency hopping, cooperative communications, …), where the error rate performance is an important metric.
Current applicable communication standards include WiFi, 4G, 5G, DVB-T, WiMax, and LTE.

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Advantages

- Best possible error rate performance with a reasonable complexity
- Limited design effort

Status of development

The technology and simulation results have been published and reviewed in peer-reviewed journals.

Intellectual property

International Patent application WO2012032074, filed on 7 September 2011 (priority date 8 September 2010)
European patent applicationEP2429083A1
Granted US patent US8982986B2

References

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Keywords

LDPC codes, precoding, mapping, labelling, fading channels, MIMO, diversity

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