

資訊與通訊技術實驗室

Information and Communication Technology Lab.

七館R70806

指導老師:李世凱老師

實驗室簡介

本實驗室主要處理資通訊系統中的實體層架構，建立基頻演算法包括同步、通道估測、等化器及通道編碼、空時編碼、編碼調變和迭代解碼方式。發展包括短距通訊、無線區域網路、行動通訊網路、展頻通訊、光磁記錄系統中的基頻處理及交互各層之間的演算法。研究觸及合作式與中繼式網路通訊。

研究成果及方向概述



5G Channel Coding

5G Multiple Access

RRM for LTE

DPC for LTE CoMP

研究方向: 5G Channel Coding

Polar Code: SC Decoder

Decoding flow: normal situation (1) with LLR example (1)

LLR (1)

u1 = 0	+0.2	+0.2	+1.5	0	-1.5
u2 = 0	+0.4	+0.2	+0.2	0	+1
u3 = 0	+0.7	+1.7	+0.2	0	+0.5
u4 = 0	+2.4	+0.7	+0.5	0	-2
u5 = 0	+0.7	-0.7	-3.5	0	-2
u6 = 1	-1.4	-1.2	+1.2	0	+0.2
u7 = 1	-2.1	+4.2	+0.7	0	+0.2
u8 = 1	-6.4	-2.7	-1.5	1	-0.5

No decoding error Received 2 hard errors

Performance Comparison of GDMA, LDS-CDMA, and SCMA for Transmissions over Rayleigh Fading Channels

Cheng-Yen Chang*, Shih-Kai Lee and Mao-Chao Lin

Abstract—Gain division multiple access (GDMA), low density spreading code division multiple access (LDS-CDMA) and Sparse code multiple access (SCMA) are non-orthogonal multiple access methods, where SCMA is a method derived from LDS-CDMA with a special design of signal constellation. We compare their performances for transmission over Rayleigh fading channels. Simulation results show that the special constellation design of SCMA does not provide any gain in Rayleigh fading channels. We show that the error performance of a sparse LDS-CDMA scheme based on 4 resources can be evaluated by applying diversity-2 concept to the Suser GDMA based on a single resource. However, by using more resources and error-correcting codes, GDMA can also achieve diversity and hence provide error rates similar to LDS-CDMA. In addition, GDMA has the advantage of low complexity.

Index Terms—GDMA, LDS-CDMA, SCMA, CSI

Performance on CQI-based SC

Scenario: Initial# of UEs = 100, RBs = 100, channel model = COST-231 Hata rural 1800.

Case 1: total# of potential UEs = (a) 120, (b) 150, by algorithm 2.

Case 2: total# of potential UEs = unlimited. (a) algorithm 1, (b) algorithm 2.

Fig. 1. UEs uniformly distributed over a cell. Fig. 2. UEs non-uniformly distributed over a cell. i.e. UE density is proportional to 1/r². e.g. UE density is proportional to 1/r.

A practical DPC (single antenna) encoder and decoder

The diagram shows the flow from input bits through LDPCCC encoder, QPSK mapping, and Viterbi algorithm to produce a signal. This signal is then processed by a channel model and a decoder consisting of a Soft VQ (BCJR CC dec), Soft de-mapper, and LDPCCC decoder using the BP algorithm.

研究方向: 5G Channel Coding

SC-List decoding with PAPR control

The diagram illustrates the SC-List decoding process where multiple candidates are generated and their PAPR values are controlled to optimize performance.

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code domain NOMA (SCMA)

The diagram shows how bit streams are mapped to sparse codewords and transmitted over orthogonal resources, with a corresponding decoding process.

MCS + CQI(RSSI) pairing & scheduling

The diagram shows concentric circles representing different CQI levels (1, 5, 7, 10, 15) and their corresponding MCS and QPSK/QAM modulation schemes.

Throughput by Using Adaptive Modulation

The graph shows throughput versus SNR for different channel conditions and modulation schemes, comparing adaptive modulation with fixed modulation.

Cross-Layer Design

The flowchart details the iterative process of generating candidates and selecting the best one based on PAPR and other criteria.

CCDF Performance

The graph shows the Complementary Cumulative Distribution Function (CCDF) performance for different numbers of candidates (1 to 15).

行政院國家科學委員會補助專題研究計畫 成果報告

A Study of Hybrid ARQ Systems Based On Channel Coding And Network Coding For Multicast or Broadcast Communications

計畫編號: NSC 97-2221-E-155-013-
執行期間: 97年8月1日至98年7月31日
計畫主持人: 李世凱
計畫參與人員: 楊定遠

Cross-Layer Issues

摘要: 本論文研究在廣播系統中如何利用在傳統單播系統中有效的LT碼來產生冗余的冗余碼，以改善廣播系統的吞吐量。由於在廣播系統中，接收者接收到的數據量不同，因此我們提出了一個使用增量冗余的自動重傳請求方案。模擬結果顯示，與其他的已知方案相比，我們提出的方案具有最少的冗余碼。

研究方向: Cross-layer Design

Cross-Layer Design Based on Fountain Codes

LT Codes for OFDM Multicast Systems with PAPR Reduction Capability

Shih-Kai Lee, Mao-Chao Lin, Hsin-Liang Chu, Feng-Chih Tsai, Hai-Yu Chen

Wireless Optical Communications

The diagram shows the transmitter chain including ACO-OFDM, clipping, power assignment, and DC-bias, and the receiver chain including FFT, ACO Equalizer & Demod, and DCO Equalizer & Demod.

The graph shows the Bit Error Rate (BER) performance versus SNR for different ACO and DCO branches under various conditions.

Programming

Programming ability: ++, matlab, or python

The block shows code examples for implementing algorithms in C++, MATLAB, and Python.

Deep learning decoding: python, tensor flow, keras

The diagram illustrates a deep learning neural network architecture used for decoding, showing input features, hidden layers, and output.