信息编码与无线传输实验室
吴湛击导师组介绍

内容

吴湛击导师简介

吴湛击，男，北京邮电大学信息与通信工程学院教授,博士生导师，1977年生，江苏宜兴人。IEEE高级会员，IEEE标准协会投票会员，北京市科学技术奖获得者（排名第一），南京市321领军科技创业人才，北京市科技英才。2004年于北京邮电大学获“信号与信息处理”专业方向的博士学位,博士学位论文“统一编译码理论与应用”获得北京邮电大学“优秀博士论文”。全国高中数学联合竞赛一等奖的获得者. 2004年7月至2006年7月，在松下电器尖端移动通信研究所做高级研究员。2006年7月至今，在北京邮电大学信息与通信工程学院任教，教授,博士生导师。

吴湛击导师简介

吴湛击老师在IEEE / IET 学术期刊和电子学报等国内外权威学术期刊上以第一作者发表论文六十余篇，出版个人学术专著两部,以第一发明人申请国家发明专利32，国际PCT发明专利3项，有20多项授权。作为项目主持人已经结题一项国家重大科技专项，一项国家自然基金项目和一项教育部科学技术研究重点项目，作为主研人也完成多项国家自然科学基金和863项目.目前正在主持多项国家项目和企业合作项目,科研经费充裕,任务量饱满.

吴湛击导师简介

吴湛击老师还是工信部所主导的LTE+标准组和IMT－advanced技术推进组都特邀的技术专家和编码调制标准技术的主要贡献者,有40多项标准技术提案被国内外的标准组织接受.现担任工信部LTE－advanced标准上行传输技术专题组的副组长。同时，还是工信部电信研究院和中国移动特邀的4G技术的评估专家和IMT-2020(5G)新型编码调制专题组副组长。另外，还与来自美国，英国和澳大利亚等国的一流学者都建立了良好的合作关系，进行着联合研究。还是国家级教学团队“通信原理”的教学骨干和信息与通信工程学院“信号系统”英语课程的负责人。

内容

实验室研究方向

- 信息论与编码调制

  LDPC码、Turbo码、网络编码、联合编码调制分集

- 无线传输技术

  MIMO、OFDM、信道建模与信道估计

  下一代无线通信的关键传输技术

- 培养多种能力

  理论分析

  软件编程（**C，C++，matlab**）

  硬件编程与调试 （**FPGA，DSP，Pico-array**）

实验室研究项目

1. 国家自然基金项目“无线网络编码调制理论与技术研究”
2. 国家重大科技专项”新一代宽带无线移动通信网”中的”IMT-Advanced开放性关键技术研究-联合编码调制分集理论与应用”
3. 国家自然基金项目“新型编码调制理论与技术研究”
4. 教育部科学技术重点研究项目”新型高效信道编码与调制技术研究”
5. 北邮-普天联合实验室2008度研究项目。
6. 华为400G高速光纤网的差分编码调制项目。
7. 国家自然基金项目“低密度校验码的理论与编译码新算法研究”
8. 国家自然基金重大项目“高速信息网中无线接入理论和技术”
9. 国家863项目“新一代蜂窝移动通信系统无线传输链路技术”
10. 国家863项目“异构无线接入网的协同机理研究”
11. 北邮-普天联合实验室2007度研究项目,。
12. 华为400G高速光纤网的高阶调制编码项目
13. 电信研究院合作项目“宽带无线接入技术业务发展及其监管政策研究”
14. 国家重大科技专项“蜂窝移动通信终端直通技术研究”

学术成果--专利

学术成果—论文

304 IEEE COMMUNICATIONS LETTERS, VOL. 12, NO. 4, APRIL 2008

A New Parity-Check Stopping Criterion for Turbo Decoding

Wu Zhanji, Peng Mugen, and Wang Wenbo

Abstract—This paper presents
criterion for Turbo decoding. Thi
check scheme, which is totally di
(CE) based criteria. Simulations s
achieves about the same performa
(BER) and saves more iterations,
known CE-based stopping criter
check scheme unveils the inner on
codes in the perspective of the d
an original theoretical discovery.

Index Terms—Turbo codes, s
scheme.

I. Introd

ITERATIVE decoding is a key
decoding iteration results in
delay. If turbo decoding approac
error performance can not be in
Often, a fixed number M is chos
for M iterations. Usually M is
frames in mind. However, mo
iterations to converge, at which
stopped by an efficient criterion
The simplest criterion is cyc
method, which terminates the ite
detects no error. But its potentia
(BER) region results in a degra
more, the extra check bits for
efficiency. A cross-entropy (CE
Hagenauer[1], which is based c
the distributions of the estimates
at each iteration. It can effectivel
with very little performance deg
computations requiring a large
low-complexity CE-based criteri
[9]. The Sign Change Ratio (S
(HAD) criteria were presented
fewer simpler computations. B
criterion, a similar Sign Differen
presented by Yufei Wu[3].An i
criterion was also proposed, whi
in the terms of BER and the ave
Additionally, an improved CE-b
which introduced two decision
referred to as the Yu criterion
to enhance performance[4].

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the review of this letter and approving
The authors are with the Wireless S
Key Laboratory of Universal Wireless Co
Beijing University of Posts & Telecom
wuzhanji@bupt.edu.cn, wuzhanji@163.c
Digital Object Identifier 10.1109/LC

IEEE COMMUNICATIONS LETTERS, VOL. 12, NO. 5, MAY 2008 383

Efficient Difference-based Decoding Implementations of LDPC Codes

Wu Zhanji, Peng Mugen, Wang Wenbo, and Li Luying

Abstract—Efficient implementations of the sum-p
rithm (SPA) for decoding low-density parity-check (
using difference-based messages between bit node
nodes are presented. As for the updates of check no
complexity derivatives are also put forward. As co
the traditional Log-Likelihood-Ratio(LLR)-based
plementations, the proposed method has much lowe
and latency, while it has no obvious loss of the error p

Index Terms—LDPC codes, sum-product decoding
based implementation.

I. Introduction

ITERATIVE decoding of low-density parity-ch
codes using the sum-product algorithm (SP
proach the capacity of the additive white Gau
(AWGN) channel. So, efficient implementation
has become a topic of increasing interest. The
plementation of the original form of SPA has
to be sensitive to quantization effects [2]. Rec
reduced complexity decoding algorithms that ope
in the log-likelihood-ratio (LLR) domain were
LLR-SPA based on Gallager's approach has
computational complexity, but it is very sensiti
tization and round-off errors, which poses a bi
for hardware implementations[5].Various reduced
derivatives of the LLR-SPA based on the Jacobi
are proposed, and both serial and parallel impl
are investigated[3]. For the check-node updates,
ations are implemented, but the computational co
direct core operations is still very high. So, for
simple hardware design, the correction terms in
operations can be executed via look-up tables o
linear functions, or even by using a single constant
two main approaches for simplified check-node
presented, which are based on the so-called m
proximation coupled with either a normalization
additive offset term[4], [5]. However, these key te
be optimized through the density evolution metho
it will cause the degradation of error performa
letter, novel difference-based implementations of S
and reduced-complexity derivatives (*w*-D-SPA) a
which are different from the LLR-SPA impleme
tally.

Manuscript received December 9, 2007. The associate edito
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The authors are with the Wireless Signal Processing and
Key Laboratory of Universal Wireless Communication, Ministr
Beijing University of Posts & Telecommunications, Beijing,
wuzhanji@bupt.edu.cn, wuzhanji@163.com).
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In Special Section on Evolution of Air-Li
Technologies for Futuristic Wireless Con

Improved coding-rot
frequency division m

W. Zhanji P. Mugen W. Wenbo

Department of Telecommunication, Beijing Un
E-mail: wuzhanji@bupt.edu.cn; wuzhanji@sina

Abstract: An improved high-spectral-efficiency c
in the orthogonal frequency division multiplexin
rotation matrix depending on the modulation or
solution of the rotation angle is proposed, and
forward to make the best use of the modulati
four-dimensional QAM rotation matrices and
improve the error performance furthermore. The
explain the convergence characteristic. Simulatio
the conventional BICM scheme.

1 Introduction

The rapidly growing need for high data rate trans
pushed the development of rotated multiphase
(MPSK)/quadrature amplitude modulation (
orthogonal frequency division multiplexing (OF
over fading channels. For example, in the thir
partnership project (3GPP), the standardization
term evolution-advanced demand a peak da
100 Mbps and a spectrum efficiency of 15
broadband transmission causes very severe mul
and inter-symbol-interference (ISI) in si
transmissions, much research has been performe
carrier transmissions. Multi-carrier transmissio
roughly classified into two types, one is OFDM
is multi-carrier code-division multiplexing (MC-
Walsh code multiplexing (WCM) [1]. OFDM
transmitted symbols into narrow-band sub-c
maintain its orthogonality between the sub-carri
OFDM can avoid ISI in a frequency selec
channel. Thus, C-OFDM (coded OFDM) with
rate forward error correction codes (FEC) can
frequency diversity gain by utilising the lit
information and parity bits from different
However, the C-OFDM with high code rates
performance because high-code-rate FEC co
obtain enough frequency diversity.
As for the bandwidth-efficient MPSK/QAM
uncoded rotated multidimensional modulation sc
independent Rayleigh fading channels are studie
distinguish from the other well-known dive
frequency, code, space), the rotated modulati

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Proceedings of ICCTA2011

A MULTI-USER C
COMPC

Qi

Wireless Sig
Beijing Univers

Abstract

The combination of spatial diversi
space diversity is supposed to provi
performance boost in communicatio
this paper, a multi-user cooperatio
proposed in order to further exploit t
the two kinds of diversity metho
constellation expansion and
de-mapping, the proposed system n
the destination receiver in comb
channels, but also enables more users
the cooperation flexibly. Moreover,
study between the proposed multi
scheme and lower order signal spac
indicates that an over 4 dB perfor
achieved.

Keywords: Component Demodul
Space Diversity; Cooperation

1 Introduction

Nowadays, the communication syste
in such a way that the transmitted c
longer confined to voice. In order
new demands associated with v
classes and therefore improve th
services (QoS), advanced alg
techniques are required to exploit
resources. Utilizing spatial diver
antennas are proved effective i
multipath fading [1] [2]. Nonetheles
is not always applicable in uplinks,
small devices such as mobile phon
nodes because of the constraints in
transmission power.

To overcome these problems and sti
advantageous features of MIMO, us
diversity are proposed [3] [4]. Devi
same cells are organized as "partn
them involved in the process is re
sending not only their own informa
that overheard from the partners.
concept, many cooperation schem
Amplified and Forward (AF), Decode

Model of independent Rayleigh faders

Z. Wu

The Jakes fading model is widely
wireless communication channels, but it
multiple uncorrelated fading waveform
modified version of the Jakes model, but it
very well. Li and Huang also proposed a n
the undesired properties. But its computat
great as that of the Jakes and Dent models.
Its correlation properties are as good as th
yet computational complexity is reduced

Introduction: The Jakes fading model is w
simulation of wireless communication chan
comings in the correlation functions. The m
strength rays arrive at the moving receiver wi
arrival angle, so the kth fading waveform
following [1]:

$$T_k(t) = \sqrt{\frac{1}{2N_0+1}}\left\{2\sum_{n=1}^{N_0}(\cos\beta_n + j\sin\beta_n)\cos(\right.$$
$$\left.+\sqrt{2}\cos(\omega_d t + \theta_{nk})\right\}$$

where k is the waveform index, $k = 1, 2, \ldots,$
maximum Doppler frequency shift with λ bei
transmitted carrier frequency. $N_0 = (1/2)($
$\beta_n = \pi n/(N_0+1)$. To generate the multiple w
that using

$$\theta_{nk} = \frac{\pi n}{N_0+1} + \frac{2\pi(k-}{N_0+1}$$

To overcome the correlation shortcoming o
suggests that the kth waveform can be genera

$$T_k(t) = \sqrt{\frac{2}{N_0}}\sum_{n=1}^{N_0} A_k(n)(\cos\beta_n + j\sin\beta_n)\cos$$

where $k = 1, 2, \ldots, N_0$, $N_0 = N/4$, $\alpha_n = (2\pi n/$
θ_n are the independent random phases, each
distributed in $[0, 2\pi)$. $A_k(n)$ is the kth Walsh-H
which stratifies

$$\frac{1}{N_0}\sum_{n=1}^{N_0} A_k^2(n)A_l(n) = \begin{cases}1, \\ 0,\end{cases}$$

But the independence between different
model is still not so good, so Li and Huang
method as the following [3]

$$T_k(t) = \sqrt{\frac{1}{N_0}}\sum_{n=0}^{N_0-1}[\cos(\omega_d\cos\alpha_{nk}\cdot t + \theta_{nk}) + j$$

where $k = 0, 1, 2, \ldots, M-1$ is the waveform
number of the different fading waveforms, eac
of N sinusoids. ω_M is the maximum Doppler fr
θ_{nk} and θ'_{nk} are the independent random ph
uniformly distributed in $[0, 2\pi)$.
To guarantee the independence, Li and H
arrival angle α_{nk} satisfies

$$\alpha_{nk} = \frac{2\pi n}{N} + \frac{2\pi k}{MN} + \alpha_0$$

the initial angle α_0 satisfies

$$0 < \alpha_0 < \frac{2\pi}{MN}, \quad \text{and} \quad \alpha_0$$

The Li and Huang model overcomes some
the Jakes and Dent models. The in-phase and q
any single fader are independent and have t
correlation functions. The independence betw
also guaranteed. But the computational comple

model is greater than that of the Jakes and Dent models, because
different sets of Doppler frequency shifts are used in the in-phase and
quadrature components of any single fader.
In this Letter, a novel model (Wu model) is proposed, which makes

A novel Joint-Coding-Modulation-Diversity OFDM System

Wu Zhanji, Wang Wenbo

Beijing University of Post and Telecommunication

P.O.B.93, Xitucheng Road No. 10, Haidian District, Beijing, China 100876
Email: wuzhanji@bupt.edu.cn, wuzhanji@163.com

Abstract- The increasing need of high data rate transmissions over the time and frequency selective fading channels has drawn attention to modulation schemes with high spectral efficiency, such as the multidimensional rotated QAM constellations, which is also referred to as the modulation diversity. An improved JCMD (Joint-Coding-Modulation-Diversity) -ID (iterative demodulation/decoding) scheme in OFDM (orthogonal frequency division multiplexing) system is proposed. For the rotated QAM (quadrature amplitude modulation), it unveils the optimum rotation matrix depends on the modulation order, code rate and iteration number. This new scheme can take full advantage of the modulation diversity of rotated QAM (quadrature amplitude modulation), the frequency diversity of OFDM system and the coding-gain of Turbo codes all together. Actually, it extends the original uncoded modulation diversity over an independent Rayleigh fading channel to a joint coding and modulation diversity over time/frequency selective fading channels. Simulation results have turned out this new scheme can significantly outperform the BICM (bit-interleaved coded modulation) scheme, which is up to 2 dB SNR gain.

Index Terms - coded-modulation, rotated modulation, OFDM, Turbo codes, modulation diversity

Introduction

The rapidly growing need for high data rate transmission has stimulated the interest of rotated MPSK /QAM (quadrature amplitude modulation) and OFDM (orthogonal frequency division multiplexing) system over fading channels. For example, in 3GPP (3rd generation partnership project), the standardizations of LTE+ (long term evolution plus) demand a peak data rate of 100M bps and a spectrum efficiency of 15 bps/Hz. Because broadband transmission causes very severe multipath effect and ISI (inter-symbol-interference) in single-carrier transmissions, much research has been performed on multi-carrier transmissions. Multi-carrier transmissions can be roughly classified into two types, one is OFDM, and another is MC-CDM (multi-carrier code-division multiplexing) with WCM (walsh code multiplexing) [2]. OFDM allocates its transmitted symbols into narrow-band sub-carriers and maintain its orthogonality between the sub-carriers, so that OFDM can avoid ISI due to a frequency selective fading channel. Thus, C-OFDM (coded OFDM) with low-code-rate FEC (forward error correction) codes can obtain the frequency diversity gain by utilizing the likelihood of information and parity bits from different sub-carriers. However, the C-OFDM with high code rates shows poor performance because high-code-rate FEC codes cannot obtain enough frequency diversity.

As for the bandwidth-efficient MPSK/QAM (quadrature amplitude modulation) modulation, uncoded rotated multidimensional modulation schemes over independent Rayleigh fading channels are studied in [1]. To distinguish form the other well known diversity (time, frequency, code, space), the rotated modulation schemes have an intrinsic modulation diversity, and the modulation diversity order is the minimum number of distinct components between any two multidimensional constellation points. The schemes are essentially uncoded and can achieve very high modulation diversity, which results in approaching- AWGN (Additive White Gaussian Noise) error performance over fading channels. However, the schemes are only suitable for independent flat fading channels without time-dispersion and cannot be directly used for frequency selective fading channels with severe ISI. So, it should cooperate with OFDM to make full use of modulation diversity and frequency diversity over the time-dispersion fading channels with ISI. Bit-interleaved coded modulation (BICM) [1],[2] is a bandwidth efficient coded modulation scheme which increases the time-diversity in fading channels. The key element of BICM is the serial concatenation of channel coding, bit-interleaving, and multilevel modulation [5-10]. N.F. Kiyani and J.H. Weber studied the rotated-MPSK OFDM scheme with BICM -ID (iterative demodulation/decoding) [5,6], which focused on two-dimensional MPSK scheme. Thorsten Clevorn , Susanne Godtmann, and Peter Vary researched the mapping of the bit patterns to the elements of the signal constellation set (SCS), and demonstrated

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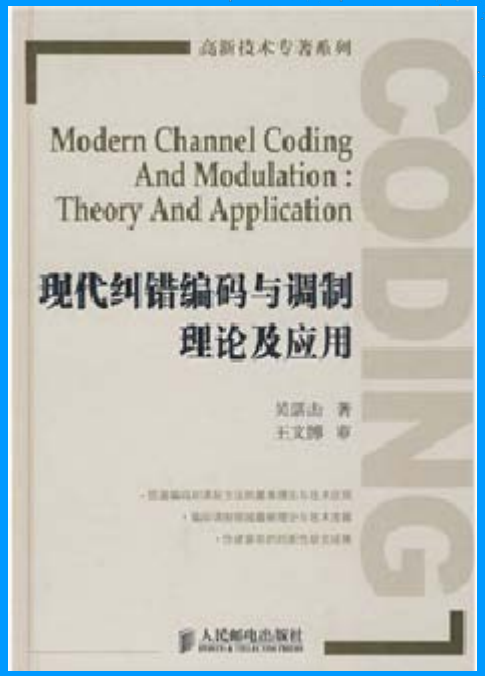
Information Coding and

学术成果--著作与提案

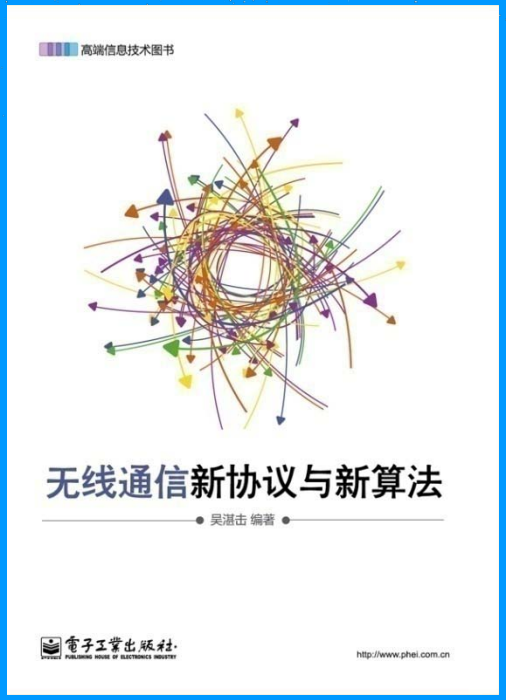


IMT-Advanced 推进组文稿提交和接纳证明

新一代宽带无线移动通信网实施管理办公室：

由北京邮电大学等单位向 IMT-Advanced 推进组提交和采纳文稿情况见下表。

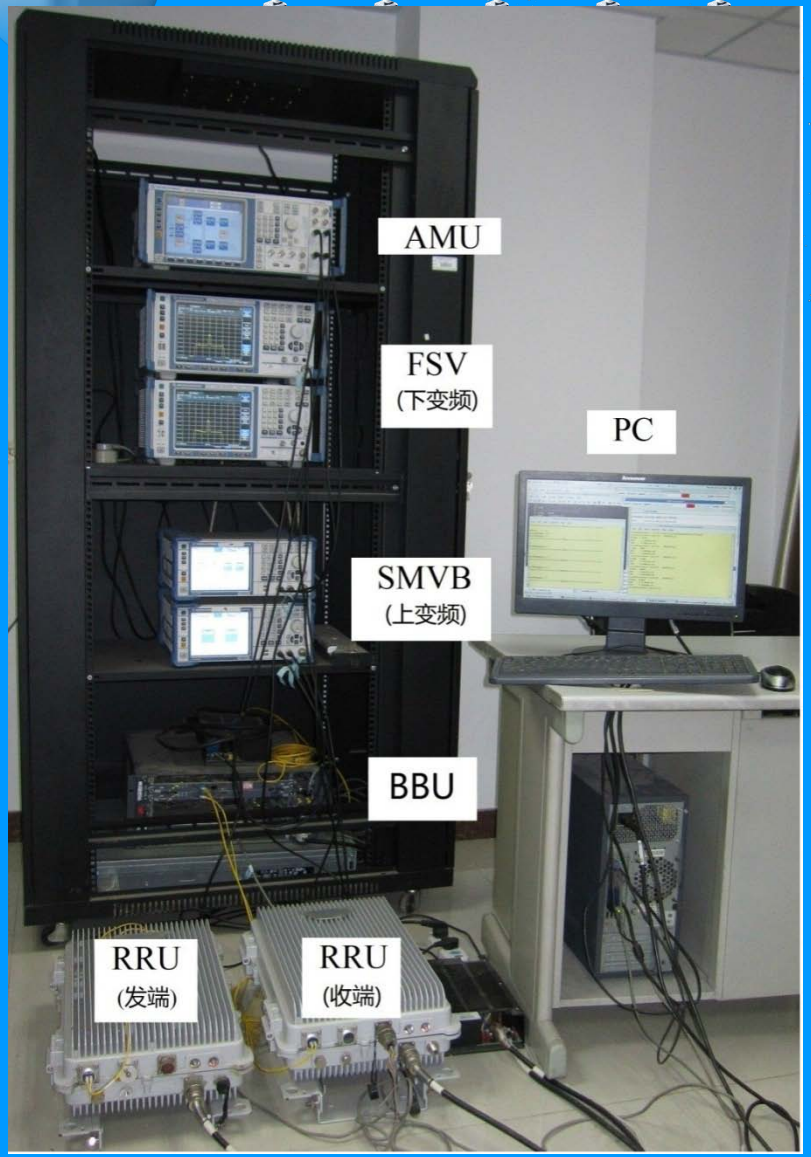
序号	文稿编号	文稿名称	采纳情况	提交单位
1	IMT-A_TECH_08014	一种增强型自适应数据重传的方法	已采纳	北邮，普天
2	IMT-A_TECH_08182	一种新的编码调制方法	已采纳	北邮
3	IMT-A_TECH_08260	一种低码率的 LDPC 码扩展方法	已采纳	北邮，普天
4	IMT-A_TECH_07255	LDPC 提案	已采纳	北邮
5	IMT-A_LTE+_08033	TP_Channel_Coding_V3	已采纳	北邮，普天
6	IMT-A_LTE+_08063	一种增强型自适应数据重传的方法	已采纳	北邮，普天
7	IMT-A_LTE+_08131	一种新的编码调制方法 V2	已采纳	北邮
8	IMT-A_LTE+_08253	Base Matrix Generation for LDPC encode process(modified)	已采纳	北邮，普天
9	IMT-A_LTE+_09504	联合编码调制分集	已采纳	北邮
10	IMT-A_LTE+_09255	Dual-layer beamforming for TDD MU-MIMO downlink	已采纳	普天
11	IMT-A_LTE+_09298	Scalable Transmit Diversity for Uplink SC-FDMA	已采纳	普天
12	IMT-A_LTE+_09352	Impact of user pairing on transparent MU-MIMO dual-layer beamforming	已采纳	普天



学术成果

- 2012年11月，吴老师承担的国家重大专项《联合编码调制分集》成功验收，其所取得的巨大成果收到了广大专家的一致认可与好评，其中，经电信研究院检测得：新的调制编码方案与现有标准方案相比，在3/4和5/6码率下，对于SISO系统，在TU6径信道，3km/h的移动速度下，可带来1~3个dB增益，对于2×2MIMO系统，在IMT-A Macro NLOS信道30km/h的移动速度下，可带来5.5~7个dB性能增益。

学术成果



测 试 报 告

测试厂商	北京邮电大学
测试内容	软件测试及硬件测试
测试依据	《软件测试规范：2009ZX03003-011-03 IMT-Advanced 开放性关键技术研究（联合编码调制）_北京邮电大学》 《硬件原型机测试规范：2009ZX03003-011-03 IMT-Advanced 开放性关键技术研究（联合编码调制）_北京邮电大学承担》
测试日期	2011 年 11 月-2011 年 12 月
测试结果	（1）软件测试：必选测试项 7 项，完成 7 项；可选测试项 0 项。 （2）硬件测试：必选测试项 2 项，完成 2 项；可选测试项 0 项。
结论意见	完成全部测试内容。 （1）软件测试中：新的调制编码方案与现有标准方案相比，在 3/4 和 5/6 码率下，对于 SISO 系统，在 TU6 径信道 3km/h 移动速度下，可带来 1～3 个 dB 性能增益；对于 2×2 MIMO 系统，在 IMT-A Macro NLOS 信道 30km/h 移动速度情况下，可带来 5.5～7 个 dB 性能增益。 （2）硬件测试中：新的调制编码方案与现有标准方案相比，在 QPSK3/4 编码方案下，对于 SISO 系统，在 TU3 径信道 60km/h 移动速度下，可带来约 2 个 dB 性能增益，对于 MIMO 系统，在 VA6 径低相关信道 60km/h 移动速度下可带来约 4 个 dB 性能增益。（备注：硬件测试与软件仿真的性能结果存在一定差异。） 签发日期 2011 年 12 月 23 日（签章）

批准：　　审核：　　主检：

学术交流

在工业应用方面,吴湛击老师先后被工信部电信研究院,中国移动研究院,华为北研所和普天研究院等邀请做专题技术报告,并且被台湾工业研究院邀请赴台北演讲和被爱立信邀请赴瑞典演讲.由于他在IEEE 802.11标准会议的所做贡献,也得到了IEEE 标准协会(SA)的关注.在2011年6月3日,被IEEE 标准协会(SA)邀请做标准发展和应用的特约专访。

内容

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2 实验室科研情况简介

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文体活动

学生就业

就业方向

- 国内外知名企业
- 出国深造
- 直博

to be continued...

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自信心

内容

联系我们

- 电话：62281058
- 邮箱：wuzhanji@bupt.edu.cn

  wuzhanji@163.com
- 地址：明光楼810室
- 实验室网站:www.wuzhanji.cn

联系我们

欢迎各位考研保研以及毕设的同学报考ICWC实验室