

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

إِنَّ فِي خَلْقِ السَّمَاوَاتِ وَالْأَرْضِ وَالْخَلَافِ الْلَّيْلِ وَالنَّهَارِ وَالْفُلْكِ الَّتِي تَجْرِي فِي الْبَحْرِ  
بِمَا يَنْفَعُ النَّاسَ وَمَا أَنْزَلَ اللَّهُ مِنَ السَّمَاءِ مِنْ مَاءٍ فَأَحْيَا بِهِ الْأَرْضَ بَعْدَ مَوْتَهَا وَبَثَ فِيهَا  
مِنْ كُلِّ دَآبَةٍ وَتَصْرِيفِ الرِّيَاحِ وَالسَّحَابِ الْمُسَخِّرِ بَيْنَ السَّمَاءِ وَالْأَرْضِ لَا يَأْتِي لِقَوْمٍ يَعْقِلُونَ

صدق الله العظيم

سورة البقرة الآية (164)

## **DEDICATION**

To each of taught me, and took my hand, and Lighted me through science and knowledge.

To both encouraged me in my journey to excellence and success.

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To each of said to me: No, it was the cause of motivational.

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# ABSTRACT

The demand for mobile communication systems with high data rates has dramatically increased in recent years. Space-Time Block Coding (STBC) is a MIMO transmit strategy which exploits transmit diversity and high reliability. In this thesis presented Orthogonal Space-Time Block Code system (OSTBC) which achieves high through-put and good performance. The main goal of this work is to provide a unified theory of OSTBCs for two and four transmit antennas and one (or more) receives antennas. OSTBCs, provide an elegant encoding and linear decoding technique while offering full diversity benefits in multiple-input multiple-output (MIMO) environments. Our design aims to improve Bit Error Rate (BER) performance, by iteratively choosing code design parameters that minimize the union upper bound on the BER. This design technique is implemented with two cases of 1 or 2 transmit antennas and 1, 2 or 4 receive antennas. Finally, conclude that the use of the proposed method (1x4) reduces the value of BER and the complexity of the system compared with other methods at different values for each of the packet numbers (500, 1000, 2000) packets and frame length (50, 100, 500) symbols so that a simple change in the value of the ( $E_b/N_o$ ) of about 1dB (value oscillating between 10 and 11 dB) at  $10^{-4}$  BER point. The results of the simulation are compatible with what is expected from the use of the OSTBC technique. The simulations show that the Orthogonal STBC design can efficiently reduce the BER and at the same time Reduce signal-to- noise ratio (SNR).

## المستخلص

ازداد الطلب على أنظمة الاتصالات المتنقلة مع ارتفاع معدلات البيانات بشكل كبير في السنوات الأخيرة. كتل شفرة الزمكان هو استراتيجية الإرسال في أنظمة تعدد المدخلات وتعدد المخرجات الذي يستغل تنوع الإرسال والموثوقية العالية. هذه الأطروحة تقدم نظام كتل شفرة الزمكان المتعامد الذي يحقق إنتاجية عالية وأداء جيد. الهدف الرئيسي من هذا العمل هو تقديم نظرية موحدة لكتل شفرة الزمكان المتعامد بإستخدام هوائي إرسال وإستخدام واحد (أو أكثر) من هوائي في الإستقبال. نظام كتل شفرة الزمكان المتعامد يوفر ترميز أنيق وتقنية فك ترميز خطية في حين يقدم فوائد التنوع الكاملة في بيئة تعدد المدخلات وتعدد المخرجات. ويهدف هذا التصميم لتحسين معدل خطأ البيانات، عن طريق اختيار معاملات تصميم كود المعلومات التي تقلل من معدل خطأ البيانات. ويتم تنفيذ هذه التقنية مع حالتين هوائي أو هوائيين للإرسال و هوائي أو هوائيين أو أربعة هوائيات للإستقبال . أخيرا، نخلص إلى أن استخدام الطريقة المقترحة (1x4) يقلل من قيمة معدل خطأ البيانات وتعقيد النظام بالمقارنة مع الطرق الأخرى عند قيم مختلفة لكل من عدد حزم البيانات (500، 1000، 2000) حزمة وطول الإطار (50، 100، 500) رمز بحيث أن قيمة نسبة الإشارة إلى الضجيج تتراوح حول 1 ديسيل (تتذبذب بين 10 و 11 ديسيل) عندما تكون قيمة معدل خطأ البيانات تساوي  $10^{-4}$ . وقد كانت نتائج المحاكاة متوافقة مع ما هو متوقع من استخدام تقنية كتل شفرة الزمكان المتعامد. تظهر المحاكاة أن تصميم كتل شفرة الزمكان المتعامد يمكن أن يقلل بكفاءة معدل خطأ البيانات، وفي الوقت نفسه تقليل نسبة الإشارة إلى الضجيج.

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## List of Abbreviations

MIMO	Multiple-Input Multiple-Output
BER	Bit Error Rate
STC	Space-time coding
STTC	Space-Time Trellis Codes
STBC	Space-Time Block Codes
OSTBC	Orthogonal Space-Time Block Codes
SISO	Single Input Single Output
SNR	Signal to Noise Ratio
SER	Symbol Error Rate
ISI	Inter-Symbol Interference
AM	Amplitude Modulation
FM	Frequency Modulation
PEP	Pair wise Error Probability
AWGN	Additive white Gaussian noise
dB	decibel
MRC	Maximum Ratio Combining
SIMO	Single Input/Multiple Output
MISO	Multiple Input/Single Output
CSI	Channel State Information
SM	Spatial Multiplexing
ML	Maximum Likelihood
LOS	Line of Sight
NLOS	No Line of Sight
BPSK	Binary Phase Shift Keying
NRZ	Non Return to Zero
QPSK	Quadrature Phase Shift Keying

RS	Reed Solomon
QAM	Quadrature Amplitude Modulation