استهلال

بسم الله الرحمن الرحيم

قال تعالى :((**قَالُواْ سُبْحَانَكَ لَا عِلْمَ لَنَا الَّا مَاعَلَّمْتَنَا انَّكَ أنْتَ الْعَلِيمُ الْحَكِيمُ**))

صدق الله العظيم

البقره (32)

DEDICATION

This work dedicated to my mighty god Allah who helps me to accomplish this project

To who guide me from darkness to lightness….

My lover prophet Mohammed

To the greatest person when open my eyes for the first time I saw her ….

My mother

To who help me to understand the life ….

My father

To those support me by giving knowledge ….

My teachers “God help them in their life”

To those stay with me in sadness and happiness….

My friends

To my lovely university....

Sudan University of Science and Technology

To ***everybody*** in my life

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ABSTRACT

Generally, Multiple Inputs Multiple Outputs (MIMO) is a promising technology for future wireless communications systems. By exploiting the multi-dimensional wireless channel created by multiple transmit and receive antennas, MIMO system significantly increase the channel capacity and link robustness of wireless communications. However, MIMO system is difficult to implement in mobile terminal due to the limitations of size and cost. The cooperative relaying system enables single antenna mobiles in a multi-user environment to share their antennas and generate a virtual multiple antenna transmitters. The relay helps the source to communicate with the destination to achieve reliable communication.

This project investigates a single relay system that aims for a reliable communication. The main goal is to study the feasibility of the proposed single relay transmission system in the mobile environment and in addition proposed appropriate coding techniques to improve the reliability in terms of Bit Error Rate (BER).

المستخلص

إستخدام عدد من الهوائيات في عمليه الإرسال والإستقبال يعتبر تقنيه واعده لأنظمه الإتصال اللاسلكيه . عن طريق هذه التقنيه أمكن إرسال أكثر من نسخه من نفس الإشاره, وبالتالي تأثير القناه على هذه الاشارات يختلف من إشاره لأخرى , لذلك يمكن لهذه التقنيه من زياده مقدار البيانات المرسله في الشبكات اللاسلكيه.ولكن هذه التقنيه من الصعب تطبيقها في أنظمه الموبايل نسبه لأنها تحتاج لمساحه كبيره وتستهلك طاقه كبيره ومكلفه ,أما في انظمه الموبايل يتطلب صغر الحجم وتقليل مقدار الطاقه المستهلكه والتكلفه. إستحدام نظام البث التعاوني يتيح لهوائيات أجهزه الموبايل بالإتصال مع بعضها البعض وتكوين نظام متعدد الارسال ومتعدد الإستقبال ,حيث يقوم الباعث بمساعده المرسل للإتصال مع المستقبل لتحقيق إتصال فعال وموثوق به.

هذا المشروع يقيم آدائيه نظام إتصال يستخدم باعث واحد الهدف منه التأكد من إمكانيه استخدام هذه التقنيه في أنظمه الموبايل بصوره عمليه , وبالإضافه إلى ذلك تم إقتراح تقنيات ترميز مناسبه لتقليل مقدار الخطأ في الإشارات المستقبله.

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LIST OF ABBREVIATIONS

SISO	Single Input Single Output
SIMO	Single Input Multiple Outputs
MISO	Multiple Inputs Single Output
MIMO	Multiple Inputs Multiple Outputs
MRC	Maximal Ratio Combining
EGC	Equal Gain Combining
SNRC	Signal to Noise Ratio Combining
FRC	Fixed Ratio Combining
ESNRC	Enhanced Signal to Noise Ratio Combining
AAF	Amplify and Forward
DAF	Decode and Forward
BPSK	Binary Phase Shift Keying
QPSK	Quadrature Phase Shift Keying
OFDM	Orthogonal Frequency Division Multiplexing
4G	Four Generation
ISI	Inter Symbol Interference
CP	cyclic prefix
FFT	Fast Fourier Transform
IFFT	Inverse Fast Fourier Transform
BER	Bit Error Rate
SNR	Signal to Noise Ratio
STBC	Space Time Block Coding

STC	Space Time Coding
ML	Maximum Likelihood
OSTBC	Orthogonal Space Time Block Coding
SP	Serial to Parallel
STTC	Space Time Trellis Codes

LIST OF SYMBOLS

S	Source
R	Relay
D	Destination
Y	Received Signal
X	Transmitted Signal
n	Complex Gaussian Noise
H	Normalized Channel Matrix
C	Capacity of the System
B	Bandwidth
SNR	Signal to Noise Ratio
n	Number of Receiving Antennas
m	Number of Transmitting Antennas
y	Total Received Signals
$\mathbf{y_{i,d}}$	Incoming Signal from Path Number i
k	Number of Different Paths
$\mathbf{y_{s,d}}$	Received Signal from the Source
$\mathbf{y_{r,d}}$	Received Signal from the Relay
$\mathbf{d_{i,d}}$	Weighting of the Incoming Signal $y_{i,d}$
$\mathbf{d_{s,d}}$	Weight of the Direct Link
$\mathbf{d_{s,r,d}}$	Weight of the Multi-hop Link
$\mathbf{h^*_{s,d}}$	complex conjugate of channel for Source signal

$\mathbf{h}_{\mathbf{r,d}}^{*}$	Complex Conjugate of Channel for relay Signal
$\mathbf{y}_{\mathbf{s,r,d}}$	Received Signal from the Source to the Relay to the Destination
$\mathbf{SNR}_{\mathbf{s,d}}$	Signal to Noise Ratio of the Signal from the Source to the Destination
$\mathbf{SNR}_{\mathbf{s,r,d}}$	Signal to Noise Ratio of the Signal from the Source to the Relay to the Destination
$\mathbf{y}_{\mathbf{s,r}}$	Received Signal in the Relay
$\mathbf{h}_{\mathbf{s,d}}$	Channel Coefficient from Source to the Destination
$\mathbf{h}_{\mathbf{s,r}}$	Channel Coefficient from Source to the Relay
$\boldsymbol{n}_{\mathbf{s,d}}$	Additive Noise Source to the Destination
$\boldsymbol{n}_{\mathbf{s,r}}$	Additive Noise from Source to the Relay
$\mathbf{P}$	Transmitted Power at the Source
$\mathbf{x}$	Transmitted Information Symbol
$\mathbf{h}_{\mathbf{r,d}}$	Channel Coefficient from Relay to the Destination
$\boldsymbol{n}_{\mathbf{r,d}}$	Additive Noise Relay to the Destination
$\boldsymbol{q}$	Function depend on which Processing is implemented at the Relay Node
$\boldsymbol{p}_{\mathbf{2}}$	Transmitted Power in the Second Phase
$\mathbf{s}_{\mathbf{1}}$	The information sequence from the first antenna
$\mathbf{s}_{\mathbf{2}}$	The information sequence from the second antenna
$\mathbf{h}_{\mathbf{i}}$	The amplitude gain
$\theta_{\boldsymbol{i}}$	Phase shift for the path from transmit antenna i to the receive antenna
$\mathbf{t}+\mathbf{T}$	The time of the received signals
$\mathbf{r}_{\mathbf{1}}$	The received signals at time t

$\mathbf{r_2}$	The received signals at time t + T
$\mathbf{n_1},\mathbf{n_2}$	Complex random variables representing receiver noise and interference
$\mathbf{r}$	The received signals
$\mathbf{S}$	Code matrix
$\mathbf{H}$	The complex channel vector
$\mathbf{n}$	The noise vector