الآيـــة

﴿فَتَعَالَى اللَّهُ الْمَلِكُ الْحَقُّ وَلا تَعْجَلْ بِالْقُرْآنِ مِنْ قَبْلِ أَنْ يُقْضَى إِلَيْكَ وَحْيُهُ وَقُلْ رَبِّ زِدْنِي عِلْماً﴾

صدق الله العظيم

سورة طه ، الآية ١١٤

Dedication

This thesis is dedicated to my father and mother, who taught me that the best kind of knowledge to have is that which is learned for its own sake.

Second to Dr. Fath Elrahman Ismael, who taught me that even the largest task can be settlement if it is done one step at a time.

In loving memory of my maternal grandmother, Zainab Mohamed Ahmed.

May Allah grant you Jannah Firdaws .... Amen

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ABSTRACT

Heterogeneous networks become a suitable selection to enhance the coverage and capacity in wireless broadband networks. However the growth in the number of femtocells and mobile stations at the enhanced Node Base station (eNB) edge underscores the need for mitigating interference. In this thesis an adaptive equalization filter with extra antenna is used in order to maintain acceptable level of interference; beside, noise reduction. The extra antenna is pointed at the main source of interference which captures the interference signals and then applied to adaptive equalization filter for the purpose of interference reduction. The complex Least Mean Square algorithm (LMS) is employed for setting coefficients of adaptive equalization filter. The system works by instructs its mobile stations to stop transmit for 3% of the Time Division Duplex (TDD) frame length. At this interval, it measures the channel power at main antenna, channel power in extra antenna and error power. The coefficients of adaptive equalization filter are locked and the system allows its mobile stations to continue transmitting. The TDD adaptive equalization filter has achieved a noticeable interference to noise ratio suppression up to 6.5dB on same cases, with 54% improvement compare with adaptive equalization filter noise canceller used as benchmark at same conditions.

المستخلص

أصبحت الشبكات غير المتجانسه إختيار مناسب لتعزيز التغطيه و السعه في شبكات النطاق العريض اللاسلكيه. إلا أن النمو في عدد المحطات اللاسلكيه الصغيره والمحطات المتنقله عند حافة البث المركزيه المعززه يؤكد الحاجه لتخفيف التداخل. في هذه الأطروحه يتم إستخدام مرشح التسويه التكيفي مع هوائي إضافي من أجل الحفاظ علي طرح كافي لكل من التداخل و الضوضاء. الهوائي الإضافي يوضع في إتجاه المصدر الرئيسي للتداخل لإلتقاط إشارات التداخل و من ثم تطبيقها على مرشح التسويه التكيفي لغرض طرح التداخل. أستخدمت خوارزمية أقل قيمه لمتوسط المربعات المركبه لضبط معاملات مرشح التسويه التكيفي. يعمل النظام بتوجيه محطاته المتنقله لوقف الإرسال لفترة ٣% من طول إيطار التوزيع بتقسيم الزمن. في هذه الفتره يقيس مرشح التسويه التكيفي قدرة القناه في كل من الهوائي الرئيسي و الإضافي وخطأ قدرة التسويه. بناءا على القياسات ضبطت معاملات مرشح التسويه التكيفي وسمح النظام لمحطاته المتنقله لمواصلة الإرسال. حقق تصميم مرشح التسويه التكيفي خمد ملحوظ في نسبة التداخل إلى الضوضاء يصل إلى ٦.٥ ديسبل على الحالات نفسها مع تحسين بنسبة ٥٤% مقارنه مع مرشح التسويه التكيفي لطرح الضوضاء أستخدم كمقياس في نفس الظروف.

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List of Symbols

Symbol	Meaning
$(I/N)_{suppression}$	Interference-to-Noise ratio suppression
X_2	Interface between eNB1 and eNB2
α	Synchronization parameter
t_{offset}	Timing difference between the time slots
t_{slot}	Is the length of the time slot
$d(n)$	Desire output
$e(n)$	Error signal
$J_{MS(n)}$	Cost function at time n
w_n	Filter coefficient at time n
r_x	Autocorrelation function of the filter input
r_{dx}	Cross correlation between the filter input and the desire response
$(I_o(n)/N_o(n))^{\|}$	Estimated I/N at the O/P of Adaptive Equalization Filter
$(I_i(n)/N_i(n))$	I/N at the O/P of the extra antenna
$E[]$	Expectation function
P	Filter order
B	O/P of the Adaptive Equalization Filter
A	I/P of the Adaptive Equalization Filter
f_{ae}	Adaptive equalization Frequency
f	Excitation interference frequency
$(I/N)_{main(dB)}$	I/N at the main antenna
$(I/N)_{extra(dB)}$	I/N at the extra antenna
R_s	Symbol-Rate
∇	Gradient
μ	Step-Size
$(I/N)_{primary}$	I/N at the primary antenna

Abbreviations

Abbreviation	Meaning
APA	Affine Projection Algorithms
BWA	Broadband Wireless Access
CN	Core Network
CLMS	Complex Least Mean Square
CSG	Closed Subscriber Group
ETSI	European Telecommunications Standards Institute
FDD	Frequency Division Duplex
FWBA	Fixed Broadband Wireless Access
HeNB	Home enhanced Node Base station
HeNet	Heterogeneous Networks
LMDS	Local Multipoint Distribution Service
LOS	Line-Of-Sight
LMS	Least Mean Square
MAI	Multiple-Access Interference
MBS	Mobile Broadband System
MMDS	Multipoint Multi-Channel Distribution Service
MUI	Multiple-User Interference
NLMS	Normalized LMS
OSG	Open Subscriber Group

PTP	Point-To-Multipoint
QAM	Quadrature Amplitude Modulation
QOS	Quality of Service
RF	Radio Frequency
RLS	Recursive Least Square
SCDMA	Synchronous Code Division Multiple Access
SIPTO	Selected IP Traffic Offloaded
TDD	Time Division Duplex
UNII	Unlicensed National Information Infrastructure
UL/DL	Uplink/Downlin