DEVELOPMENT OF NEW MODEL FOR MULTIWAVELET-BASED OFDM OVER WIRELESS CHANNEL AND ITS IMPLEMENTATION IN FPGA

By

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LIST OF ABBREVIATIONS

1D	One dimension
3GPP	3rd Generation Partnership Project
4G	4th Generation
ADSL	Asymmetric Digital Subscriber Line
AWGN	Additive White Gaussian Noise
BER	Bit Error Rate
BPSK	Binary Phase Shift Keying
BUFG	Global Buffer
CCDF	Complementary Cumulative Distribution Function
CLB	Configurable Logic Block
CP	Cyclic Prefix
CWT	Continuous Wavelet Transform
DAB	Digital Audio Broadcasting
dB	Decibel
DFT	Discrete Fourier Transform
DMWCST	Discrete Multiwavelet Critical-Sampling Transform
DMWOST	Discrete Multiwavelet Over-Sampling Transform
DMWT	Discrete Multiwavelet Transform
DSP	Digital Signal processing
DVB	Digital Video Broadcasting
DWT	Discrete Wavelet Transform
FDM	Frequency Division Multiplexing
FEC	Forward Error Correction

FF	Flip-Flop
FFT	Fast Fourier Transform
FPGA	Field Programmable Gate Array
GHM	Geronimo, Hardian, and Massopust
GI	Guard Interval
HDSL	High-bit-rate Digital Subscriber Line
HPA	High Power Amplifier
I/O	Input/Output
ICI	Inter-Carrier Interference
IC	Integrated Circuit
ICWT	Inverse Continuous Wavelet Transform
IDFT	Inverse Discrete Fourier Transform
IDMWCST	Inverse Discrete Multiwavelet Critical-Sampling Transform
IDMWOST	Inverse Discrete Multiwavelet Over-Sampling Transform
IDMWT	Inverse Discrete Multiwavelet Transform
IDWT	Inverse Discrete Wavelet Transform
IEEE	Institute of Electrical and Electronics Engineers
IFFT	Inverse Fast Fourier Transform
IOB	Input Output Block
ISI	Inter-Symbol Interference
ISW	Inverse Sliding Window
JTAG	Joint Test Action Group
LCA	Logic Cell Array
LDPC	Low Density Parity-Check
LLR	Log-Likelihood Ratio

LOS	Line-Of-Sight
LTE	Long Term Evolution
LUT	Look-Up Table
MAP	Maximum A Posteriori
MCM	MultiCarrier Modulation
MIMO	Multiple-Input Multiple-Output
MLE	Maximum Likelihood Estimation
M-PSK	M-ary Phase Shift Keying
M-QAM	M-ary Quadrature Amplitude Modulation
MRA	Multi-Resolution Analysis
OFDM	Orthogonal Frequency Division Multiplexing
P/S	Parallel-to-Serial
PAPR	Peak-to-Average Power Ratio
PLD	Programmable Logic Device
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RSC	Recursive Systematic Convolutional
RTL	Register Transfer Level
S/P	Serial-to-Parallel
SISO	Soft-Input Soft-Output
SNR	Signal-to-Noise Ratio
SW	Sliding Window
TC	Turbo code
VDSL	Very-high-speed Digital Subscriber Line
VHDL	Very high speed Hardware Description Language

Wi-Fi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Network
XSG	Xilinx System Generator

LIST OF SYMBOLS

T_m	Delay spread
T_s	Symbol time interval
B_c	Coherence bandwidth
f_c	Carrier frequency
v	Speed of the source
c	Speed of light
f_d	Doppler frequency
B_d	Doppler spread
T_c	Coherence time
α	Attenuation of different paths
u	Number of samples that the maximum channel delay spread
$z(n)$	AWGN
N_{ISI}	Number of interfering symbols
N_f	Number of subcarrier
$(.)^*$	Complex conjugate process
$A_c(t)$	Carrier amplitude
$\phi_c(t)$	Carrier phase
$g(kT_s)$	General inverse Fourier transform function
$S_c(t)$	Carrier signal
$S_s(t)$	Complex signal of OFDM signal
ω	Angular frequency
T_u	OFDM symbol duration
Δf	Subcarriers spacing

T_g	Guard interval duration
N_g	Number of guard interval
$s(n)$	Transmitted signal
$r(n)$	Received signal
$\psi(t)$	Wavelet function (mother wavelet)
$\varphi(t)$	Scaling function
a	Scale parameter
b	Translation parameter
$\mathbb{R}$	Set of real numbers
$\mathbb{Z}$	Set of all integers
$h(k)$	Scaling filter coefficient
$g(k)$	Wavelet filter coefficient
h	Low pass filter of the DWT
g	High pass filter of the DWT
$\tilde{h}$	Low pass filter of the IDWT
$\tilde{g}$	High pass filter of the IDWT
$D_f(j,k)$	Wavelet (detailed) coefficients
$C_f(j,k)$	Scaling (approximation) coefficients
$\Phi(t)$	Multiscaling function
$\Psi(t)$	Multiwavelet function
H	Low pass filter of the DMWT
G	High pass filter of the DMWT
$\tilde{H}$	Low pass filter of the IDMWT
$\tilde{G}$	High pass filter of the IDMWT

H_k	Multiscaling filter coefficients
G_k	Multiwavelet filter coefficients
R_c	Code rate
L_c	Constraint length
m_c	Memory of convolutional encoder
d_{free}	Free distance of convolutional encoder
$\Lambda(.,I)$	Input port of SISO refer to the LLR
$\Lambda(.,O)$	Output port of SISO refer to the LLR
W_1	Transformation multiwavelet matrix
W_2	Reconstruction multiwavelet matrix
P	Matrix of pre-filter coefficients
Q	Matrix of post-filter coefficients
I	Identity matrix
R_M	Number of real multiplications
R_A	Number of real additions
R_O	Total number of real operations
N_c	Number of useful subcarriers
M	Order of the modulation
Z_c	Null subcarriers
P_c	Pilot subcarriers
D_c	Data subcarriers
H_e	Channel frequency response
c	Codeword of the channel coding
d	Binary random input data
G_c	Generator matrix of the LDPC code