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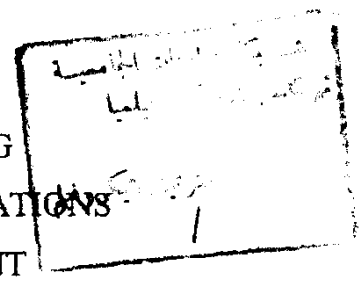

Test of Multipath Fading Microwave Radio Channel Simulators

A Thesis Submitted in Partial Fullfilment of the M.Sc. Degree
in Electronics and Communications Engineering

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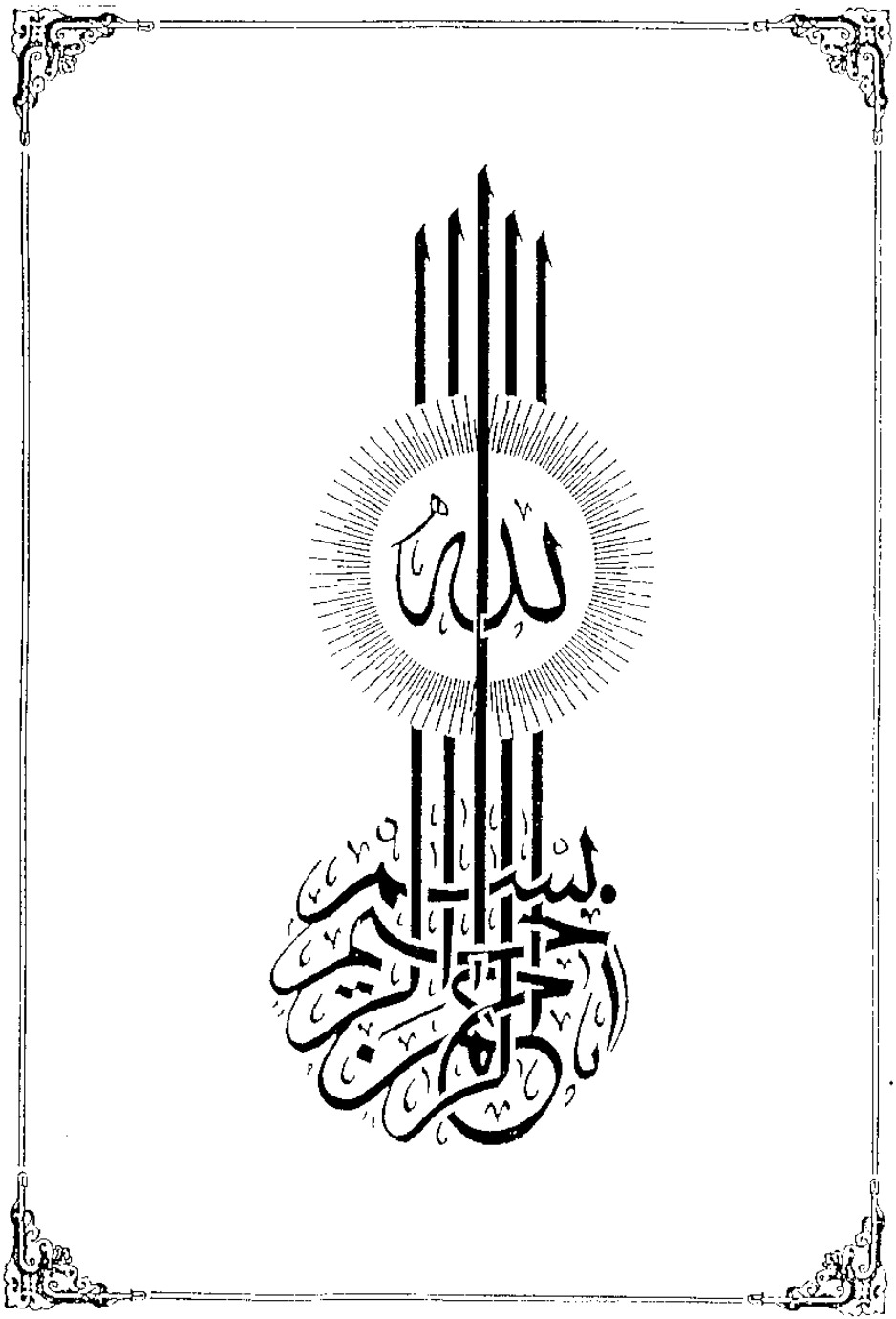

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To
My Parents

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Statement

This dissertation is submitted to Ain Shams University for the degree of M.Sc. in Electrical Engineering.

The work is included in this thesis was carried out by the author in the department of Electronics and Communications Engineering, Ain Shams University. from December 1991 to September 1994.

No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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Abstract

This work is concerned with the simulation of multipath fading channel. Software and hardware simulators are utilized to predict the performance of digital microwave radio systems during fading instants. The new diversity models for digital radio are included in the channel model to give more accurate results. The TCM technique is tested as an efficient error correction coding for fading channels. To get low values of BER with a small samples size, the modified Monte-Carlo simulation technique is inquired.

Results of the hardware and the software simulations are compared and a good agreement is found between them.

List of Symbols and Abbreviations

α	Roll-off factor.
a	Scaling factor of fading channel model in absolute value.
A	Scaling factor of fading channel model in dB value.
AGC	Automatic Gain Control.
AM	Amplitude Modulation.
AWGN	Additive white Gaussian Noise.
b	Shaping factor of fading channel model in absolute value.
B	Shaping factor of fading channel model in dB's value.
BER	Bit Error Rate.
BER$^{\backslash}$	Biased Bit Error Rate.
BER**	Unbiased Bit Error Rate.
BW	Bandwidth.
C/I	Carrier-to-Interference Ratio.
CL	Constraint Length.
C/N	Carrier-to-Noise Ratio.
CPD	Cross Polarization Ratio.
CRI	Cross-Rail Interference.
$\delta(t)$	Dirac Delta Function.
D_{ave}	Average Displacement Factor.

DIF	Diversity Improvement Factor.
DFE	Decision-Feed back Equalizer.
DFM	Dispersive Fade Margin.
E/η	Energy-to-Noise Density Ratio.
d_{free}	Free Distance of Coded Signal Set.
ϕ	Phase Shift of the Indirect Ray.
f_b	Bit Rate.
f_c	Center-Frequency.
FCC	Forward-Error Control.
FFM	Flat Fade Margin.
f_s	Symbol Rate.
F(x)	Probability Density Function of Random variables (x).
Γ	Signal-to-Distortion Ratio.
Γ_o	Threshold Value of the Signal-to-Distortion Ratio.
H(f)	Fading Channel Transfer Function.
$H_{eq}(f)$	Equalizer Transfer Function.
IBPD	In-Band Power Difference.
IF	Intermediate Frequency.
ISI	Intersymbol Interference.
LME	Least Mean Error.
LMS	Least Mean Square.
MASK	M-ary Amplitude Shift Keying.
MFSK	M-ary Frequency Shift Keying.
MMSE	Minimum Mean Square Error.
MPSK	M-ary Phase Shift Keying.
MQAM	M-ary Qadrature Amplitude Modulation.
NF	Noise Figure.
n(t)	Noise Signal.

NBW	Noise Bandwidth.
$n_c(t)$, $n_s(t)$	Orthogonal Components of the Noise Signal.
n_e	Number of Error Samples.
N_t	Number of Total Samples.
P_1, P_2	Power of Received Signal at Two Tones (f1) and (f2) respectively.
$P(b, f_n)$	Joint Probability Density Function of b and f_n.
PDF	Probability Distribution Function.
$P_{o,rel}$	Relative Outage Probability.
PM	Phase Modulation.
p(t)	Baseband Bandlimited Pulse.
pp(t)	Destroyed Baseband Bandlimited Pulse.
$pp_{re}(t)$ and $pp_{im}(t)$	Real and Imaginary Parts of pp(t).
p(t)	Detected Pulse.
r	Fading Occurrence Probability.
RF	Radio Frequency.
σ	Standard Deviation of a Gaussian Random Variable.
S/N	Signal-to-Noise Ratio.
S_{ri}	Amplitude of the I or the Q-Rail of the received symbol at the sampling instant.
S_{ti}	Amplitude of the I or the Q-Rail of the transmitted symbol at the sampling instant.
τ	Relative Delay between the direct and the indirect rays.
T	Symbol Duration.
TCM	Trellis-Coded Modulation.
T_d	Outage Time Due to Dispersion Only.
T_f	Fading Time/Year.
T_n	Outage Time Due to Noise Only.

T_N	Noise Temperature.
T_{out}	Total Outage Time.
t_s	Sampling Epoch.
ω_n	Notch Radian Frequency.
z	IBPD in Absolute Value.
z_o	Threshold Value of the IBPD.
Z	IBPD in dB Value.
ZF	Zero Forcing.

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