Name of Student**:**	Roll No.	Date:

Experiment No. 7

Aim: To study the outage probability, LCR & ADF in SISO for Selection Combining and MRC.

Theory

Small scale fading characterizes the fluctuation of signal (strength) over a spatial distance of fraction of wavelength. The fluctuation is also observed in both time and frequency domain at a gain location. The variation of signal (strength) at the receiver is due to random interference between the different copies of the transmitted signal. The interference is sometimes constructive and sometimes destructive. The multiple copies of the transmitted signal are generated due to scattering, reflection, and diffraction due to obstacle present in the path of radio signal between the Tx and Rx movement of the Tx and Rx or the obstacle cause time domain variation of the signal (strength) and the phenomenon is called Doppler effect. Since each path of the radio wave may exhibit difference doppler its cumulative effect results in spread of the carrier/ frequency content of the signal and hence is also known as Doppler spread.

If v is the maximum velocity (m/s) then the maximum Doppler shift is given by
fm=υ(m/s)c=
Where,

- c=velocitylight=3∗108m/s.=*h*=3∗10*8
- fc=carrierequency.

Coherence time is defined as interval in time over which the signal remains correlated. It is defined as
Tc= 9/16ΠIfm (s)
If symbol duration Ts << Tc it experience slow fading while if Ts>Tc it experience fast fading. The enveloped level crossing rate is defined as the rate at which the signal envelope crosses a specified level R in the positive (or negative) going direction.
It requires the joint pdf (α,.α) of the enveloped level α=|r| and enveloped slope .α=|r|
LR=√2π(k+1)fmρe−k−(k+1)ρ2I0(2ρ√k(k+1))ρ=R√Ωp=RRrms
Rrms=√Ωp is the enveloped level

Rayleigh fading (k=0) and isotropic scattering LR=√2πfmρe−ρ2
Level Crossing Rate For Selection Combining
Lr=fm√πMγ√σexp(−γ22σ)[1−exp(−γ22σ)]M−1
Where,

- fm is the Maximum doppler frequency.
- σ is the r.m.s value of the received signal voltage.
- γ is the threshold voltage.
- M = No. of channels

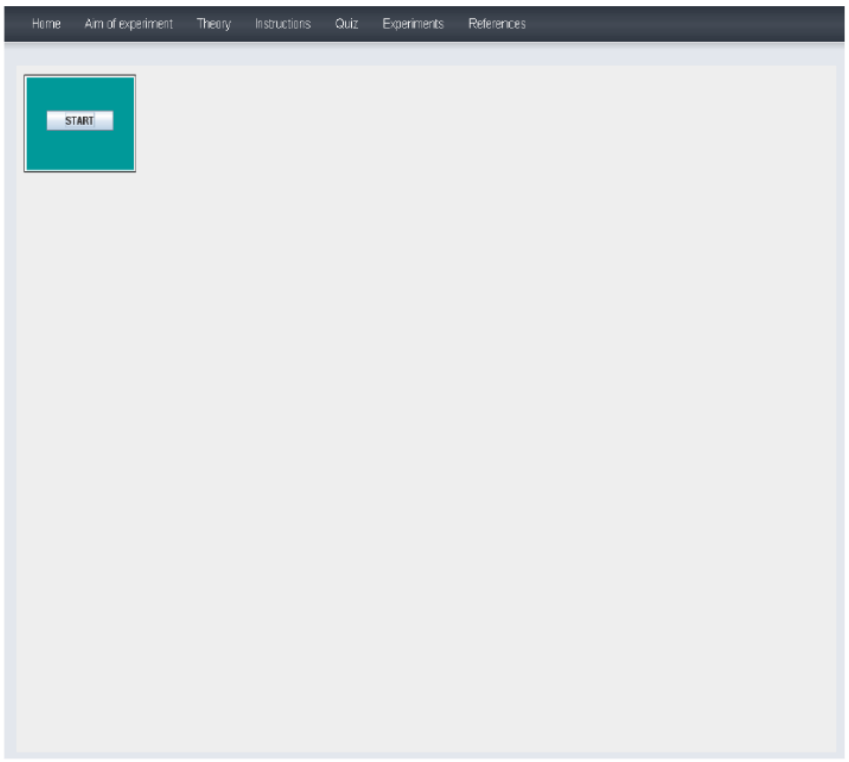
Average enveloped fade duration
The average duration the enveloped remains below a specified level R.
t=1NRPr[r≤R]
Average fade duration For Selection Combining
ADF=√ρ∗exp(γ22σ−1)√2πfdMγ
For Rayleigh distribution fading
Pr[r≤R]=∫R0Pr(dr)=1−exp(−ρ2)
¯t=eρ2−1ρfm√2π In case of flat fading the plot of signal enveloped of transmitting 'r' is given as
p(r)=rσ2exp(−r22ρ2)(0≤r≤∞)
=0(r <0)
Where,

- σ is the r.m.s value of the received voltage signal before detection.
- σ2is the time average power of the received signal before enveloped detection.

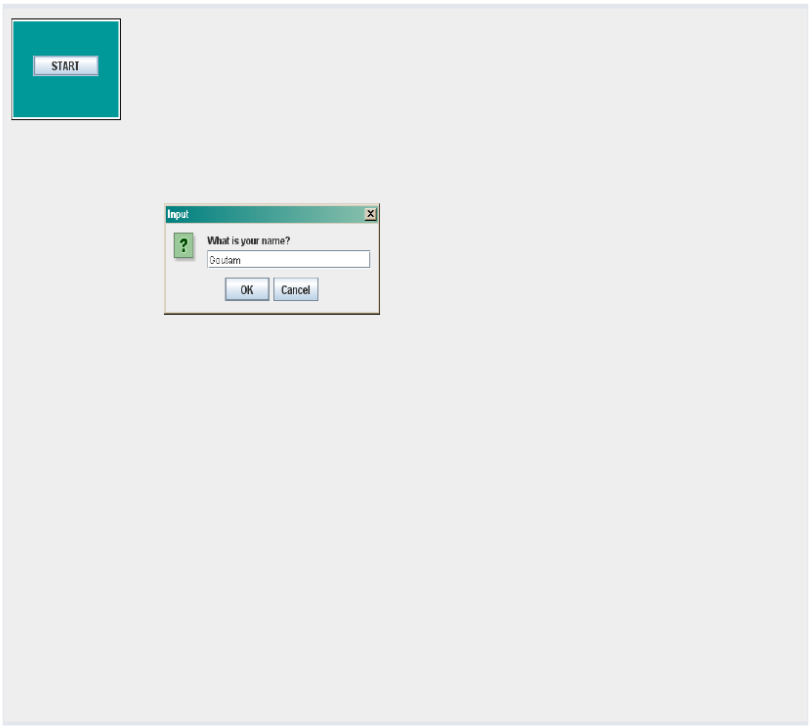
Probability of outage is defined as
P(R)=Pr(r≤R)=∫R0p(r)dr=1−exp(−R22σ2)
The mean value rmean of rayleigh distribution is given by
rmean=E[r]=∫∞0rp(r)dr=σ√π2=1.2533σ=1.2533
σ2r=E[r2]−E2[r]=∫∞0r2p(r)dr−σ2π2
=σ2(2−π2)=0.4292σ2

Instructions for Experiment: - Flat Fading

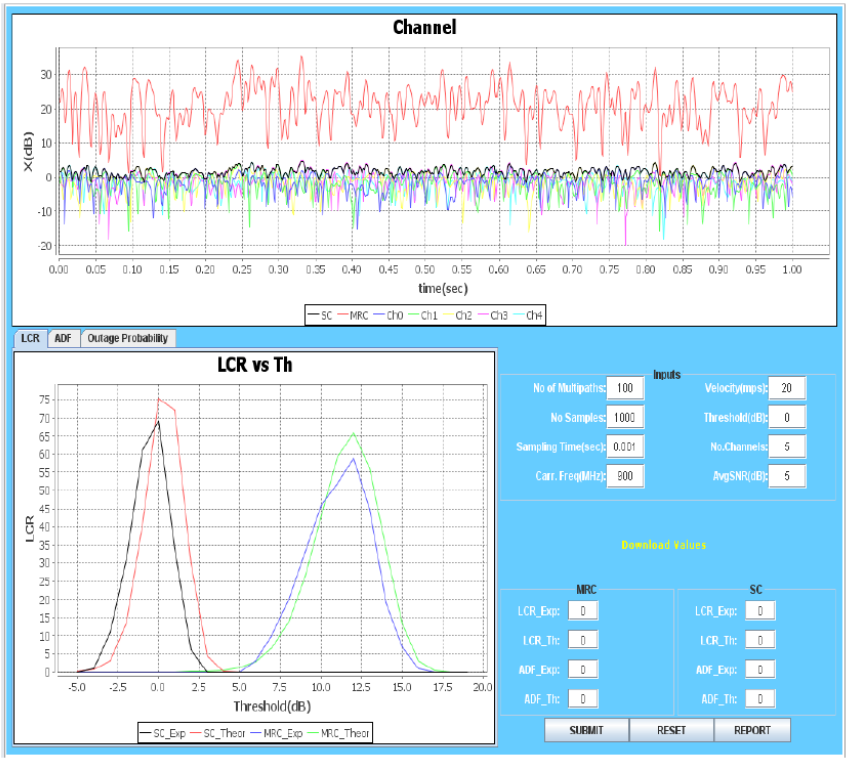
- Step1:- Click on the button START. A page appears with a dialogue box asking for your name.

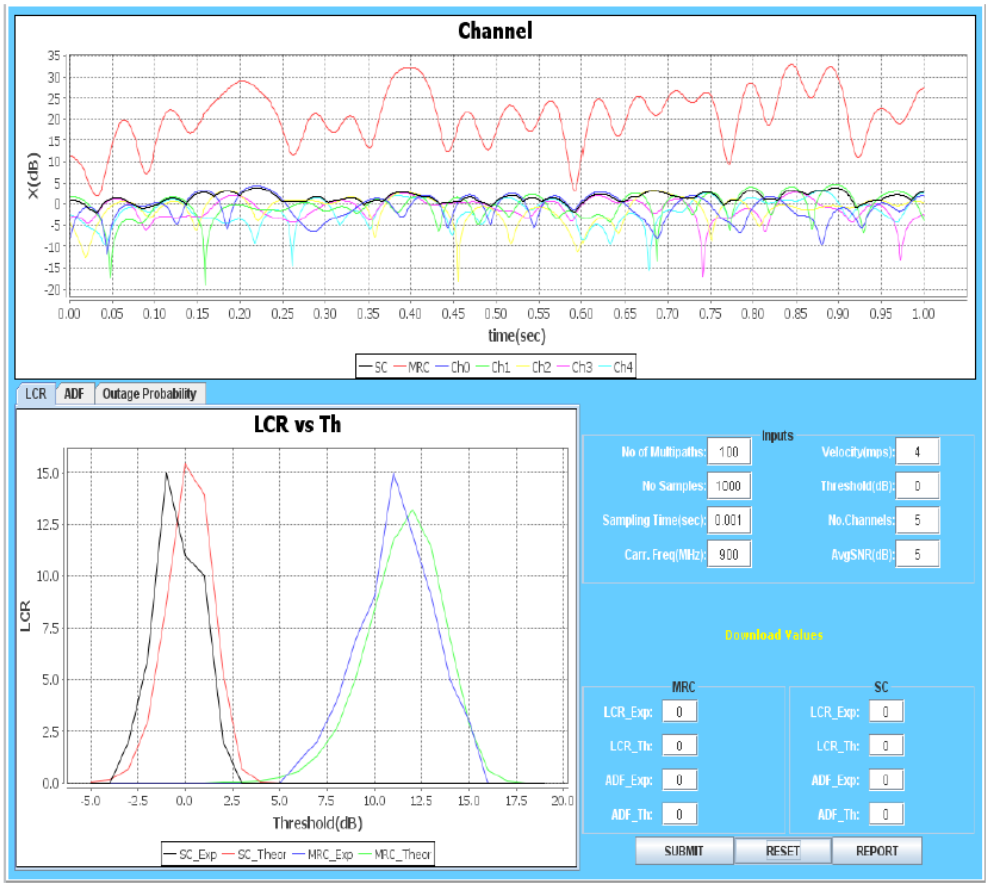


- Step 2:- Enter your name then Click Ok.

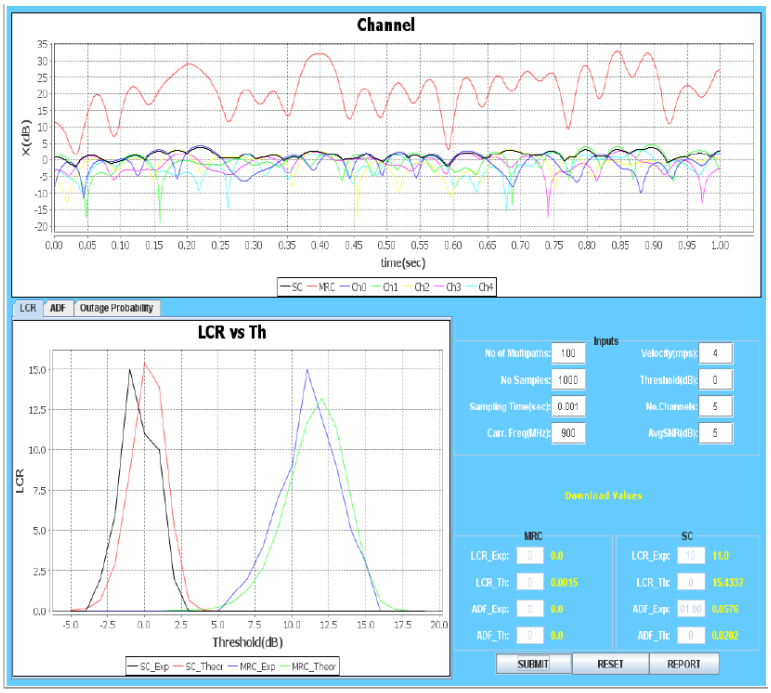


Step3: - Enter the input parameters value. Then click on "RESET" Button. Observed the waveform.

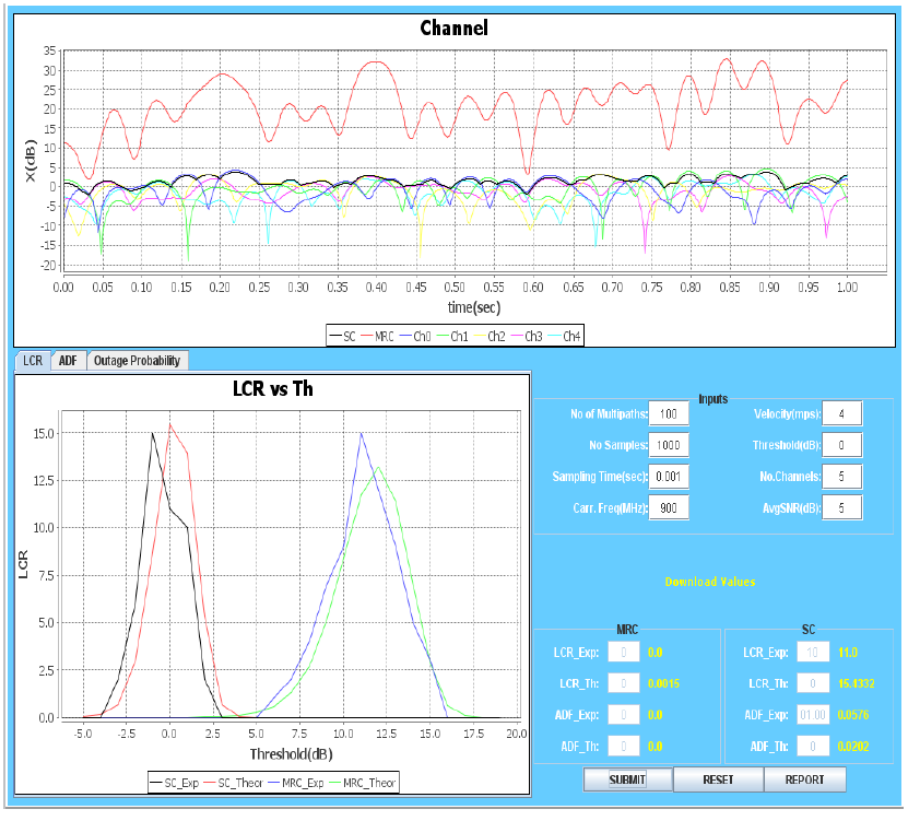

Channel
X(dB)
time(sec)
SC MRC Ch0 Ch1 Ch2 Ch3 Ch4
LCR ADF Outage Probability
LCR vs Th
LCR
Threshold(dB)
SC_Exp SC_Theor MRC_Exp MRC_Theor
Inputs
No of Multipaths: 100
Velocity(mps): 20
No Samples: 1000
Threshold(dB): 0
Sampling Time(sec): 0.001
No.Channels: 5
Carr. Freq(MHz): 900
AvgSNR(dB): 5
Download Values
MRC
SC
LCR_Exp: 0
LCR_Th: 0
ADF_Exp: 0
ADF_Th: 0
SUBMIT
RESET
REPORT


Channel
X(dB)
time(sec)
SC MRC Ch0 Ch1 Ch2 Ch3 Ch4
LCR ADF Outage Probability
LCR vs Th
LCR
Threshold(dB)
SC_Exp SC_Theor MRC_Exp MRC_Theor
Inputs
No of Multipaths: 100
Velocity(mps): 4
No Samples: 1000
Threshold(dB): 0
Sampling Time(sec): 0.001
No.Channels: 5
Carr. Freq(MHz): 900
AvgSNR(dB): 5
Download Values
MRC
SC
LCR_Exp: 0
LCR_Th: 0
ADF_Exp: 0
ADF_Th: 0
SUBMIT
RESET
REPORT

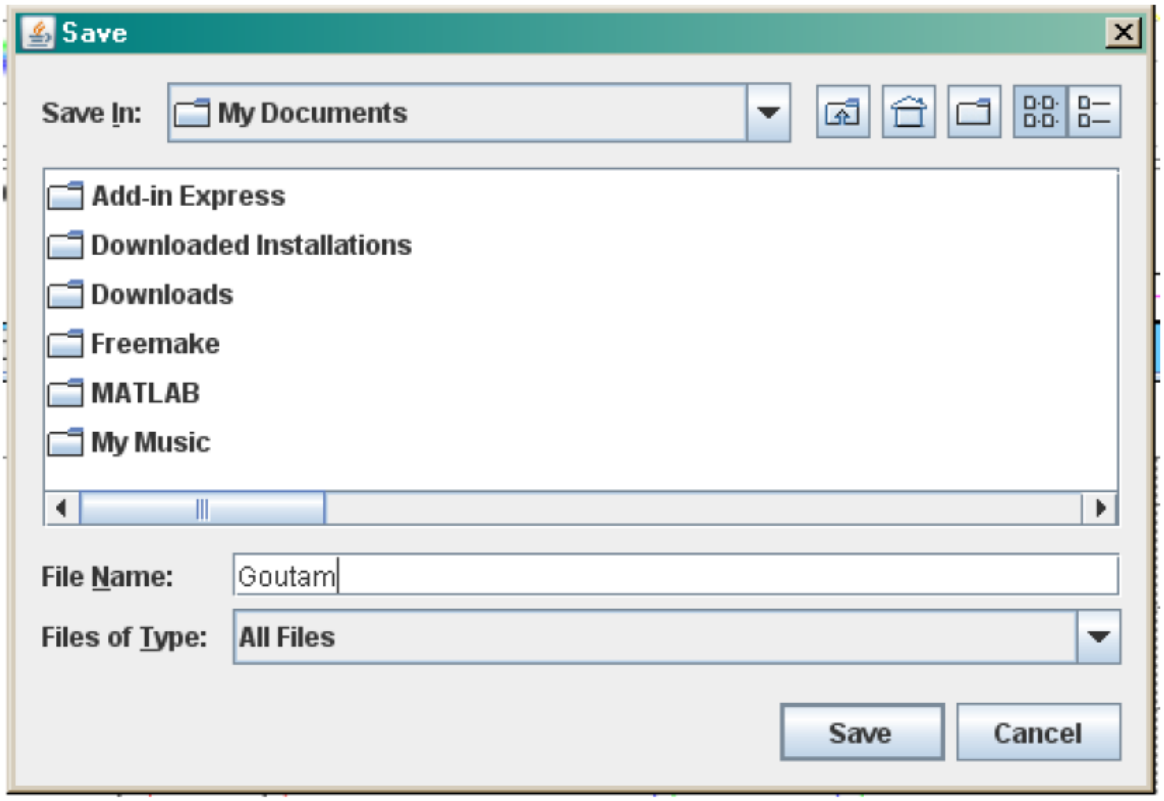
- Step4: - Enter value of LCR Exp and ADF Exp in both MRC and SC from the waveform. Then Click on "SUBMIT" Button.



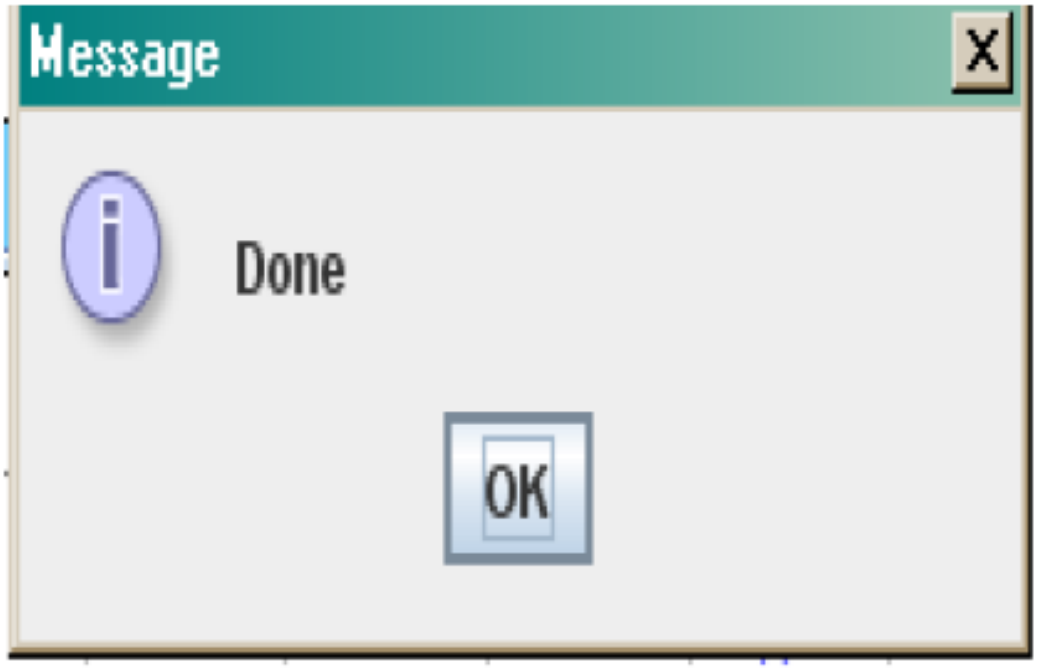
- Step5:- Click on the "Report" button.



- Step6:- PDF report of the experiment is generated.



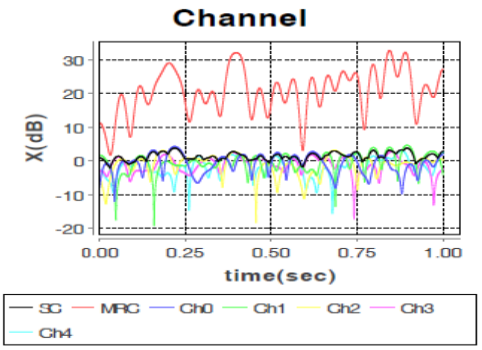
- Step7:-After generation of the Report you will get following message.

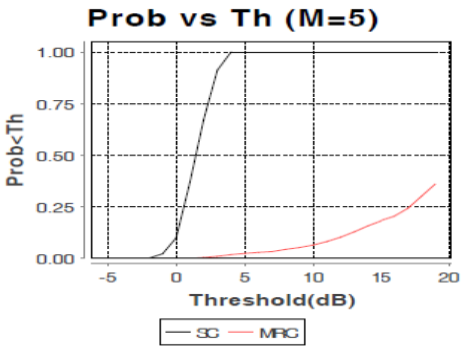


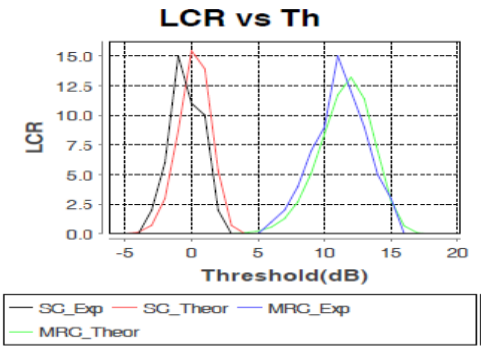
- Step8:- Click on the "Ok" and you will get your Report.

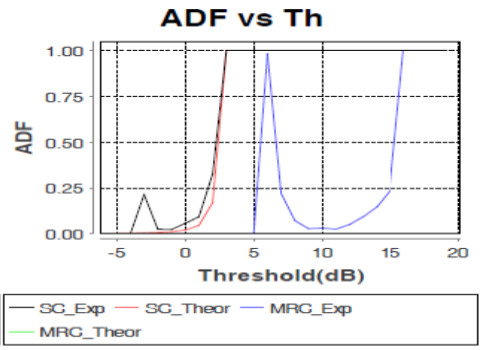
Fading Channels &Mobile Communications
IIT Kharagpur
Date: Nov/6/2012

Exp9: Flat Fading
Name: GOUTAM









Input Parameters	
No.of Multipaths	100
No.Samples	1000
Sampling Time(sec)	0.001
fc(Hz)	9.0E8
Velocity(mps)	4.0
Threshold(dB)	0.0
No.of Branches	5
Avg SNR(dB)	5.0

Results				
Type	LCR(Exp)	LCR(Th)	ADF(Exp)	ADF(Th)
SC(Actual)	11.0	15.4332	0.0576	0.0202
SC(Entered)	10.0	0.0	1.0	0.0
MRC(Actual)	0.0	0.0015	0.0	0.0
MRC(Entered)	0.0	0.0	0.0	0.0

- Step9: - To Redo the experiment click on "RESET" button.

Conclusion:

FAQ;

1. What is Flat Fading?
2. What is the difference between flat and selective fading?
3. What are the types of fading?

Checked By:

Name of Subject Teacher	Sign with Date