To study the capacity of correlated Nakagami–m fading using maximal ratio combining

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Abstract – In this review paper we calculate closed-form expressions for the capacity of dual-branch maximal ratio combining diversity systems for correlated Nakagami-*m* fading channels. Because the final capacity expressions contain infinite series, we truncate the obtain series and present upper bounds on the truncation errors. The corresponding expressions for Rayleigh fading are obtained as a special case of Nakagami-*m* fading.

Index Terms – Channel capacity, correlated Nakagami-*m* fading, diversity combining technique.

1. INTRODUCTION

The capacity of the channel have great role in the designing of wireless communication system because of its demand is growing day by day very rapidly .In all of that nakagami-m fading channel using maximal ratio combining technique have great importance by taking assumption that the identically distributed and independent diversity branch used. The capacity of correlated Nakagami-*m* fading channels with MRC was investigated in [9] for ORA adaptive transmission techniques. The capacity expressions in [9] were obtained by using a probability density function (PDF). In this paper, we investigate the effect of correlation on the capacity of Nakagami-*m* fading channels for different diversity combining techniques.

2. OBJECTIVE

The objective of this paper in to calculate the capacity of the nakagami-m fading channel at various correlation coefficient. We also calculate the capacity for different value of the fading parameter. We calculate the capacity for the different value of average SNR by taking different truncation term in the capacity formula.

Capacity of correlated Nakagami-*m* fading channels with MRC-

Diversity is an effective method for increasing the received signal-to-noise (SNR) in a flat fading environment without increasing transmitter power The capacity of a flat fading channel can be obtained by averaging the capacity of an additive white Gaussian noise (AWGN) channel, which is given in [19] as $C = B \log_2(1 + \gamma)$, over the distribution of γ for the fading channel $P\gamma$ (γ), where B is the channel bandwidth (Hz) and γ is the instantaneous received SNR. Therefore, the average capacity C of a flat fading channel, which is also known as the ergodic capacity, can be expressed as [1]

$$\langle C \rangle_{ora} = B\int_0^{\infty} \log_2(1+\gamma) p_\gamma(\gamma) d\gamma \quad (1)$$

The PDF of the SNR at the output of an MRC combiner $P\gamma$MRC(γ) for dual correlated Nakagami-*m* fading channels can be presented as

$$p_{\gamma MRC}(\gamma) = \frac{\left(m\gamma/\bar{\gamma}\right)^{2m-1} \exp(-a\gamma)\, {}_1F_1\left[m;2m;2b\sqrt{\rho\gamma}\right]}{\left(\bar{\gamma}/m\right)(1-\rho)^m \Gamma(2m)}, \gamma \geq 0 \quad (2)$$

Where $a = m/\left(\bar{\gamma}\left(1-\sqrt{\rho}\right)\right)$

$b = m/\left(\bar{\gamma}(1-\rho)\right)$

${}_1F_1[\cdot;\cdot;\cdot]$ is the confluent hyper geometric function of the first type [12].

m-fading parameter

put the value of PgMRC(g) from equation (2) to equation(1) after solving the expression the final result will be as follows

$$\eta_{MRC} = \frac{C}{B} = \frac{C^m}{(ln2)\Gamma m} \exp(a) * \sum_{n=0}^{\infty} \frac{\Gamma(m+n)(d)^n}{n!} * \sum_{z=0}^{n+2m-1} (a)^z \, \Gamma(-z, a) bits/sec/Hz$$

Where

$$d = \frac{2(\sqrt{\rho} - \rho)}{1 - \rho}$$

$$c = \frac{\left(1 - \sqrt{\rho}\right)^2}{(1 - \rho)}$$

3. RESULTS

If we plot the graph of the capacity in MATLAB then result will be as follow

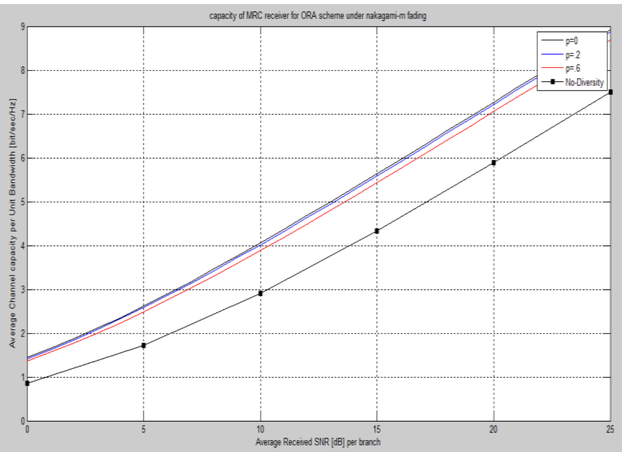

Fig.1. Average channel capacity per unit bandwidth of ORA scheme versus average received SNR under Nakagami-m fading.(for m=1)

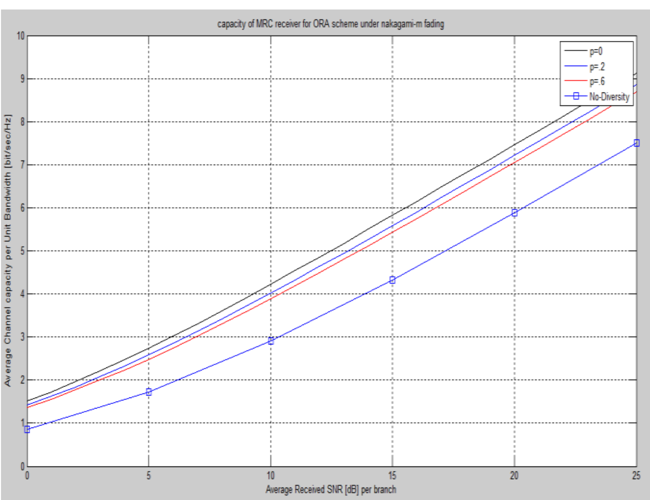

Fig.2. Average channel capacity per unit bandwidth of ORA scheme versus average received SNR under Nakagami-m fading(for m=2)

4. NUMERICAL RESULTS AND ANALYSIS

Figs. 1 and 2 show the capacity per unit bandwidth of a dual-branch MRC system over correlated Nakagami-*m* fading channels for $m = 1$ (for Rayleigh fading) and $m = 2$, respectively, as a function of $\bar{\gamma}$ for $\rho = 0$, 0.3, and 0.6. For comparison, the channel capacity of Nakagami-*m* fading channels without diversity, which was obtained in [4], is presented in Figs. 1 and 2. It is seen in Figs. 1 and 2 that MRC diversity improves the capacity of Nakagami-*m* fading channels. It is also seen that more improvement is achieved on channels with severe fading ($m = 1$) than those with less fading severity ($m = 2$). It is observed in Figs. 1 and 2 that the capacity is largest when $\rho = 0$ and decreases as ρ increases; however, the decrease in capacity due to correlation diminishes as *m* increases.

g(in db)	Capacity(bits /sec/Hz)N=20	Capacity(bits/sec/Hz)for N=40	error
0	1.4234	1.4236	0.0002
5	2.5825	2.5827	0.0002
10	4.0149	4.0152	0.0003
15	5.5873	5.5877	0.0004
20	7.2172	7.2176	0.0004
25	8.8678	8.8683	0.0005

Table 1- for different term used in the capacity expression shown above.

5. CONCLUSION

We have derived closed-form expressions for the capacity of dual-branch MRC channel which shows that if the value of the correlation coefficient is increased the performance of the channel is degraded in terms of capacity. we have also calculated the truncation error for fading parameter m=1 condition which shows that as the SNR increases the error is increased.

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