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Gray Level Based Power Adaptation for Wireless Transmission of Images

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Abstract- Gray level Slicing is to highlight a specific range of gray values. Power Adaptation methods are presented for gray level slicing approaches. Power Adaptation methods aims in optimization of the resulting bit error rate by gray level slicing without preserving background and gray level slicing with background. This paper gives us an achievable increase in the proposed method rather than the conventional method with a better quality and the bit error rate is also optimized in proposed method rather than the former method with acceptable quality.

Index Terms- Bit error Rate (BER), Gray level slicing, Power Adaptation, Wireless Channels

I. Introduction

By the advent of multimedia communications and the information superhighway has given rise to an enormous demand on high-performance communication systems.Multimedia transmission of signals over wireless links is considered as one of the prime applications of future mobile radio communication systems. However, such applications require the use of relatively high data rates (in the Mbps range) compared to voice applications. With such requirement, it is very challenging to provide acceptable quality of services as measured by the bit error rate (BER) due to the limitations imposed by the wireless communication channels such as fading and multipath propagation. Furthermore, the user mobility makes such a task more difficult because of the time varying nature of the channel. The main resources available to communications systems designers are power and bandwidth as well as system complexity. Thus, it is imperative to use techniques that are both power and bandwidth efficient for proper utilization of the communication resources.

Power Adaptation has been an effective approach in the transmission of 2D signals over wireless channels. In the process of transmission, Quality is the major feature of the signal. Several enhancement techniques are used to emphasize and sharpen 2D signal features for display and analysis. Consequently, the enhancement methods are application specific and are often developed empirically. Some enhancement algorithms use both the spatial and frequency domains. The type of techniques includes point operations, where each pixel is modified according to a particular equation that is not dependent on other pixel values; mask operations, where each pixel is modified according to the values of the pixel's neighbors (using convolution masks); or global operations, where all the pixel values in the 2D signal are taken into consideration. Spatial domain processing methods include all three types, but frequency domain operations, by nature of the frequency transforms, are global operations. Of course, frequency domain operations can become "mask operations," based only on a local neighborhood, by performing the transform on small image blocks instead of the entire image. Enhancement is used as a preprocessing step in some computer vision applications to ease the vision task, for example, to enhance the edges of an object to facilitate guidance of a robotic gripper.

Gray-scale modification (also called gray-level scaling) methods belong in the category of point operations and function by changing the pixel's (gray-level) values by a mapping equation. The mapping equation is typically linear (nonlinear equations can be modeled by piecewise linear models) and maps the original gray-level values to other, specified values. Typical applications include contrast enhancement and feature enhancement.The primary operations applied to the gray scale of an image are to compress or stretch it.

II. SYSTEM MODEL

The system model utilizes two different approaches for gray level slicing- Gray Level slicing without preserving background and Gray Level slicing with background. In the first approach, high values are displayed for a range of interest and low values in other areas. But the background information is discarded. In the second approach, the objective is to display high values for the range of interest and original gray level values in other areas. This approach preserves the background of the image. A binary phase shift keying digital communication system is considered for image transmission. Initially, the image is gray level sliced, sampled, quantized, and then coded into binary bits for transmission by the system. Each sample is coded into M bits. The transmitted signal is represented as

$$S(t) = \sum_{k=0}^{\infty} \sum_{i=0}^{M-1} \sqrt{w_i}\, b_{ki}\, g(t-(kM+i)T_b) \quad (1)$$

Where w_i is the transmitted power and b_{ki} is the information data (±1) of the ith bit in the kthi block of the M bits representing one of the samples, g(t) is a rectangular pulse shape of transmitted signal, and Tb is the bit duration. Index i represents the location of a bit within the M bits belonging to the same sample with M-1 the representing the most significant bit (MSB) and index 0 representing the least significant bits (LSB).The wireless channel is the AWGN channel.

III. POWER ADAPTATION METHODS

In this paper the power Adaptation methods are implemented on the images based on the gray level slicing approaches. Many algorithms for allocating power among the wireless channels exist. However, these methods are either optimal and computationally efficient, but slow to obtain power Adaptation. Current methods for power Adaptation fall into two categories: Conventional method and proposed method. The Conventional Method is a simple and widely used method of power Adaptation in wireless channels. The power allocated to each bit in the transmission is equally distributed i.e. conventional method treats all bits equally which is generally used. The Proposed Power Adaptation method based on the transmitted bits according to their significance on the message quality. The proposed scheme was based on adjusting the amount of power transmitted for each bit according to its importance in the image quality as measured by the mean square error.

In this paper we focus on BER performance as the metric to be optimized. Utilizing the approximate expression for BER , an optimum power Adaptation is calculated such that the end-to-end average BER performance is minimized.

Fig.1Table showing RMSE, PSNR, BER of Proposed Power Adaptation-With Background

PROPOSED POWER ADAPTATION-WITH BACKGROUND			
Eb/No	**RMSE**	**BER**	**PSNR**
0	0.8678	0.1065	49.3965
1	0.7599	0.0814	50.5496
2	0.6417	0.058	52.018
3	0.5053	0.036	54.0935
4	0.36	0.0182	57.0386
5	0.2033	0.0058	62.0003
6	0.0835	0.001	69.7281
7	0.0159	0	84.1548
8	0	0	Inf
9	0	0	Inf

Fig.2 Table showing RMSE, PSNR, BER of Conventional Power Adaptation

CONVENTIONAL POWER ADAPTATION			
Eb/No	**RMSE**	**BER**	**PSNR**
0	0.2613	0.0076	59.8236
1	0.2629	0.0077	59.7693
2	0.2624	0.0077	59.7845
3	0.2605	0.0075	59.8499
4	0.2644	0.0078	59.72
5	0.2581	0.0074	59.9298
6	0.2627	0.0077	59.7758
7	0.262	0.0076	59.7975
8	0.2633	0.0077	**59.7564**
9	0.2649	0.0078	59.703

Fig.3Table showing RMSE, PSNR, BER of Proposed Power Adaptation-With Out Background

PROPOSED POWERADAPTATION-WITH OUT BACKGROUND			
E_b/N_o	**RMSE**	**BER**	**PSNR**
0	0.2303	0.0059	60.9185
1	0.1676	0.0031	63.6802
2	0.1159	0.0015	66.886
3	0.0855	0.0008	69.524
4	0.0556	0.0003	73.2653
5	0.0366	0.0001	76.8971
6	0.0083	0	89.7975
7	0	0	Inf
8	0	0	Inf
9	0	0	Inf

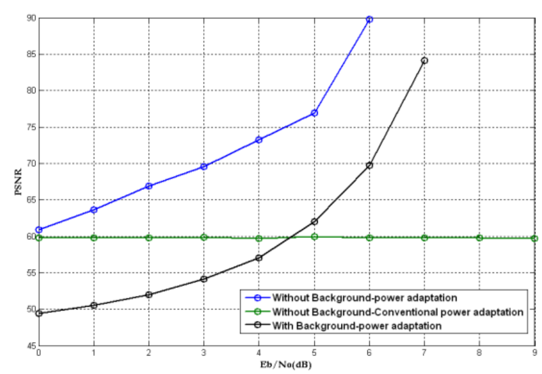

Fig.4 Plot Showing PSNR values of Proposed, Conventional Power methods with and without background

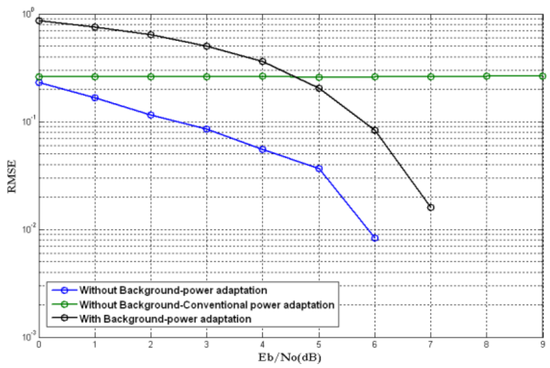

Fig.5 Plot Showing RMSE values of Proposed, Conventional Power methods with and without background

Fig.6 Gray level slicing with background preservation

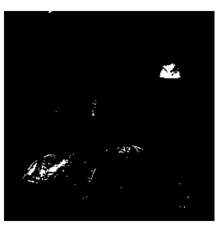

Fig.7 Gray level slicing without background preservation

IV. NUMERICAL RESULTS

Fig.1,2 and 3 represents Table showing RMSE, PSNR, BER of Proposed Power Adaptation-With Background, Conventional Power Adaptation Proposed Power Adaptation-With Out Background

Fig.6 Graylevel slicing with background preservation and Fig.7 shows the graphical representation of Graylevel slicing with background preservation and Fig.3,4,5 shows the plots of E_b/N_o versus PSNR,RMSE and BER for Power Adaptation Methods Fig.4 shows Graylevel slicing without background preservation and fig.6 shows graphical representation of Graylevel slicing without background preservation. At lower values of Eb/No,the proposed power Adaptation method performs better than the conventional method in terms of BER.

V. CONCLUSIONS

In this paper power Adaptation using proposed method showed better performance compared to conventional method transmitted over a wireless channel .The bit error rate is optimized in proposed method using any of the approaches of gray level slicing.

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