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Reduction of Vignetting On Pixelated System Using Spatial OFDM

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ABSTRACT: Optical Wireless Communication (OWC) systems can be used as an alternative to radio frequency systems for short range indoor communications. OWC has several appealing attributes including low cost, high security, unlicensed bandwidth and simplicity. Multiple-input multiple-output (MIMO) OWC systems have the potential to provide higher data rates than their single-input single-output counterparts. However, research has shown that non-imaging MIMO systems provide little diversity gain. The use of imaging rather than non-imaging systems may provide a solution to this problem. Basically vignetting causes attenuation and intercarrier interference (ICI) in the spatial frequency domain. In this approach spatial asymmetrically clipped optical OFDM (SACO-OFDM) is proposed to minimize the effect of vignetting. The sizes of the transmitted image and its distance from the lens centre have an impact on the maximum level of vignetting.

KEYWORDS: ICI, imaging, MIMO, OFDM, optical wireless communication, vignetting

I. INTRODUCTION

The growing ubiquity of cameras in hand-held devices and the prevalence of electronic displays in signage creates novel frame work for wireless communications. Traditionally, the term MIMO is used for multiple-input multiple-output where the multiple-input component is a set of radio transmitters and the multiple-output component is a set of radio receivers. In this paper it presents a real-time messaging paradigm and its implementation in an operational visual MIMO optical system. As part of the system, develop a novel algorithm for photographic message extraction which includes automatic display detection, message embedding and message retrieval. Experiments shows that the system achieves an average accuracy of 94.6% at the bit rate of 6222.2bps. Optical Wireless Communication (OWC) systems can be used as an alternative to radio frequency systems for short range indoor communications.

OWC has several appealing attributes including low cost, high security, un licensed band width and simplicity. The vignetting effect reduces the performance of amulti-input multi-output (MIMO) wireless communication system. A gradual fall-off in illumination at the edges of a received image will occur due to the vignetting effect. In order to improve the performance of the pixelated MIMO optical wireless communication system the Non-DC-Biased spatial orthogonal frequency division multiplexing (OFDM) is adopted in the previous work to reduce the effect of vignetting for a pixelated system. Optical wireless communication (OWC) systems can be used as an alternative to radio frequency systems for short range indoor communications. OWC has several appealing attributes including low cost, high security, unlicensed bandwidth and simplicity. Multiple-input multiple-output (MIMO) OWC systems have the potential to provide higher data rates than their single-input single-output counterparts. However, research has shown that non-imaging MIMO systems provide little diversity gain. The optical wireless communication can mainly classified into three such as short range, long range and ultra-long range. The short range communication is used in the indoor communication that is communication inside a room. Pixelated systems used in the short range communication. The long range communication is applicable for the communication up to the range of 7 kms. Image or infrared is used for long range communication. Ultra range communication isused for the communication from satellite to base station and base station to satellite. For this infrared is used. In optical wireless communication the data is transmitted by using light wave. So it is a high speed communication and is used for long distance communication. Multiple input

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multiple output is a technology which is used in both the transmitter and receiver equipment of a wireless communication system. The term MIMO is used for multiple-input multiple-output where the multiple-input component is a set of radio transmitters and the multiple-output component is a set of radio receivers. It employs the concept of visual MIMO where pixels are transmitters and cameras are receivers. In this manner, the techniques of computer vision can be combined with principles from wireless communications to create an optical line-of-sight communications channel. Two major challenges are addressed. The message for transmission must be embedded the result is observed. It uses multiple antennas both at the input and the output side for the transfer of data between the multiple end users.

The message is hidden from the observer and the electronic display can simultaneously be used for its originally intended purpose (e.g.signage, advertisements, maps) Photometric and geometric distortions during the imaging process corrupt the information channel between the transmitter display and the receiver camera. The vignetting effect reduces the performance of a multi-input multi-output (MIMO) wireless communication system. One form of MIMO imaging scheme is a pixelated system, where the transmitter transmits a series of pixelated images and a lens along with an array of photo detecting element reproduces the images at the receiver.

II. THEORETICAL BACKGROUND

In the proposed system, the effect of vignetting in a pixelated system and the method for reducing this effect are described. Spatial asymmetrically clipped optical OFDM isused for the reduction of vignetting. Vignetting causes attenuation of sub carriers. It also causes ICI which causes an extranoise - like term in the received sub carriers. In the pixelated MIMO system the spatial orthogonal frequency division multiplexing is applied. The spatial asymmetrically clipped optical OFDM (SACO-OFDM) and spatial dc biased optical OFDM (SDCO-OFDM are used to remove the vignetting effect. Although, for an optical wireless communication system the spectral and power efficiency are the most important objective to improve. But still the spectral and power efficiency are not up to the mask by the existing method. Hence from the proposed method it can improve the spectral and power efficiency by using the non-dc-biased spatial OFDMA. The performance of pixelated multiple-input multiple-output optical wireless communication systems can be impaired by vignetting, which is the gradual fall-off in illumination at the edges of areceived image. This project investigates the effect of vignetting for a pixelated system using spatial orthogonal frequency division multiplexing (OFDM).

The analysis shows that vignetting causes attenuation and inter carrier interference (ICI) in the spatial frequency domain. MATLAB simulations indicate that for a given constellation size, spatial asymmetrically clipped optical OFDM (SACO-OFDM) is more robust to vignetting than spatial dc biased optical OFDM (SDCO-OFDM). Moreover, for the case of SDCO-OFDM, the very large zeroth sub carrier causes severe ICI in its neighbourhood causing flattening of the bit error rate (BER) curves. It shows that this BER floor can be eliminated by leaving some of the lowerspatial frequency sub carriers unused. The BER performance can also be improved by applying a vignetting estimation and equalization scheme. Finally, it is shown that equalized SACO-OFDM with 16-QAM has the same over all data rate as equalized SDCO-OFDM using 4-QAM. The main objective of a pixelated system is to enhance the image quality reproduced in the output. In case of the optical wireless communication, the pixelated MIMO system is used for the image transmission. In the pixelated MIMO system the spatial orthogonal frequency division multiplexing is applied. The spatial asymmetrically clipped optical OFDM(SACO-OFDM) and spatial dc biased optical OFDM (SDCO-OFDM) are used to remove the vignetting effect. Although, for an optical wireless communication system the spectral and power efficiency are the most important objective to improve. But still the spectral and power efficiency are not up to the mask by the existing method. Hence this proposed method is used to improve the spectral and power efficiency by using the non-dc-biased spatial OFDMA.

The proposed system shown that vignetting also causes attenuation of subcarriers, but that unlike fractional mis alignment and defocus blur, the attenuation is the same for all subcarriers, independent of spatial frequency. Because of the different underlying mechanisms, the three components of attenuation are independent and the overall attenuation for a given subcarrier can be calculated by multiplying the individual attenuation factors for fractional misalignment, defocus blur and vignetting. Vignetting, unlike fractional misalignment and defocus blur also causes ICI which causes an extra noise-like term in the received subcarriers. This ICI noise is also enhanced by the equalizer, and in this way interacts with the attenuation caused by all the impairments. In SACO-OFDM only the odd subcarriers are used to carry data. It has been shown that when an SCO-OFDM signal is a symmetrically clipped all clipping noise falls on even subcarriers.

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III.ARCHITECTURAL DESCRIPTION

Transmitter

The system consider first the case of SACO-OFDM. For each transmitted frame, the input data is mapped on to the N1byN2 matrix of constellation points given by the equation given below.

$X_{0,0} \quad X_{0,1} \quad X_{o,2}\ldots \quad X_{0,N2-1}$

$X= \; X_{N1-1,0}\, X_{N1-1,1} \; X_{N1-1,2}\cdots X_{N1-1,N2-1}$

The elements of matrix, X, are selected from the signal constellation being used. To ensure a real output signal from the 2-Dinverse fast Fourier transform (2- DIFFT),the input matrix must have Hermitian symmetry. For SACO-OFDM the data must be mapped in to the odd-index columns of X and the even-index columns set to zero, so that clipping noise does not affect the wanted signal.

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Receiver

The receiver performs the inverse operations to the transmitter. The receivedpixels,ql1, l2, are converted back to an electrical signal by the DD detectors. Next the CP and CPo are removed.

$Yl_{1,}l_{2}=Rpql_{1,}l_{2}+zl_{1,}l_{2}$

IV.RESULTS AND DISCUSSION

The vignetting image is transmitted through the transmitter.

Fig 1:Inputvignettingimage

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The image consist of number of pixels .Each pixel constitutes binary zero and binary ones. So the transmitted image is a digital signal

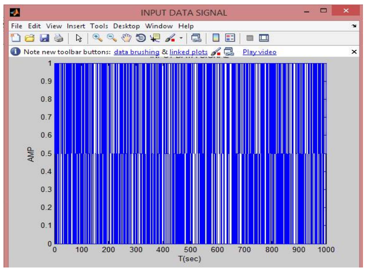

Fig2:Inputdigitalsignal

The receiver performs the inverse operations to the transmitter. Next the CP and CPo are removed. The receiver uses a serial to parallel converter. It convert the serial input to parallel output. The s/p converter converts the serial input to parallel output and the result is shown in figure4.3.

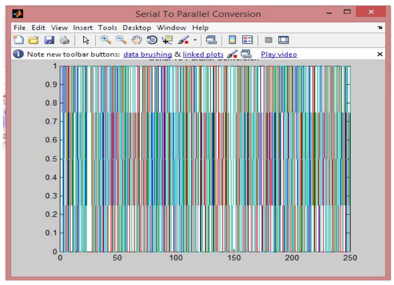

Fig3:Serialtoparallelconverteroutput

The receiver contains Photo detecting elements which convert the digital input signal to analogy form Charge-coupled device (CCD) cameras, arrays of photodiodes, complimentary metal – oxide – semiconductor imagers are some of the devices which can be used as direct detection (DD) receivers.

LCDs and cameras are widely available in many hand held devices including laptops, tablet computers, personal digital assistants and smart phones and this creates a great opportunity for pixelated wireless communication. The direct detector is used in the receiver side to obtain a coded output. From the direct detector we can get the output. It convert the pixelated input to analog signal which is to be obtained at the output.

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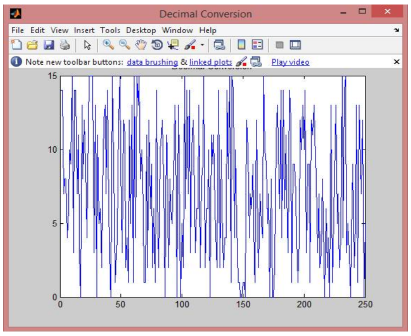

Fig4:Codedoutputsignal

Then the analog signal is modulated by using an intensity modulator. Then the intensity of the analog signal is increased.

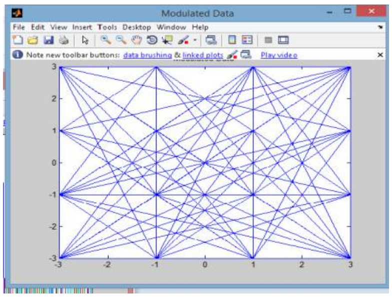

Fig5:Modulatedoutput

This modulated signal is given to the optical channel. The optical channel includes alens. The performs centralisation of light.

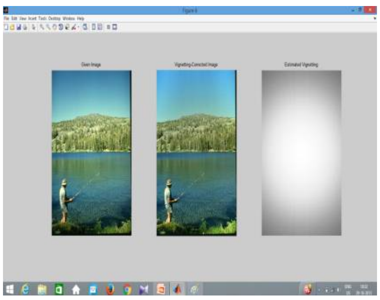

Fig6: Vignettingestimation

The vignetting can be evaluated with respect to BER performance for different r values and to a vignetting free system has the r values of 0.4,0.6,0.8 and 1 and are compared with vignetting free system.

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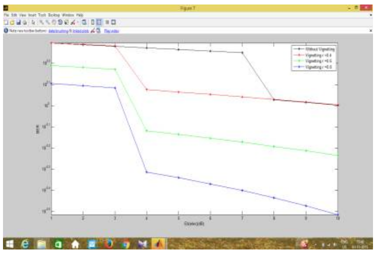

Fig7: Performance analysis

BER performance of SACO-OFDM is compared with that of SDCO- OFDM. To make a fair comparison, 16-QAMSACO-OFDM should be compared with 4-QAMSDCO-OFDM.This is because SACO-OFDM uses only half of the subcarriers to carry data, and as a result, SACO-OFDM has half the spatial spectral efficiency of SDCO-OFDM for the same constellationsize. The figure4.7 describe the results obtained from MATLAB simulations of systems with and without vignetting. Unless otherwise stated the parameters used in the simulations are$r1= r2=r=1$, CP/CPo=10% (rounded up to the next and bDC=2σx.

V.CONCLUSION

Multiple-input multiple-output (MIMO) OWC systems have the potential to provide higher data rates than their single-input single-output counterparts. However, research has shown that non-imaging MIMO systems provide little diversity gain. The use of imaging rather than non-imaging systems may provide a solution to this problem. It results a vignetting free transmission of images through a pixelated system in the indoor applications. That is the transmission of images in a single room. Due to vignetting the quality of the received image will reduces. The main objective of a pixelated system is to enhance the image quality reproduced in the output. One form of MIMO imaging scheme is the pixelated system, where the transmitter transmits a series of pixelated images, and a lens along with an array of photo detecting elements reproduces the images at the receiver. Such systems have the potential to provide high data rate transmission by exploiting spatial diversity at a large scale.

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