IRAQI JOURNAL OF APPLIED PHYSICS
Vol. 14, No. 1, January-March 2018, pp. 27-30

Application of Multiple Coded Frame Temporal Processing to Enhance Digital Image Transfer for High-Definition Communications Systems

Ahmed M. Abbas

Department of Physics,
College of Science,
Thi Qar University,
Nasiriya, IRAQ
ahmed.abbas85@yahoo.com

In this work, a multiple coded frame temporal processing is proposed as a protocol to enhance the digital image processing in digital communications systems. This protocol is based on the dissembling of visual data packages into multiple coded frames and transmitting them over secured temporal route. Data transfer involves the reliable delivery of transparent data between the users. All data are delivered in sequence with no duplication or missing parts Three main parameters were controlled in order to examine the proposed protocol and its applicability to enhance the quality of digital image at the reception stage.

Keywords: Ternary compound; Thermal evaporation; Thin films; Structural characteristics
Received: 13 January 2017; **Revised**: 21 February 2018; **Accepted**: 28 February 2018

1. Introduction

Recently, digital communications have become one of the most fundamental requirements in all human being societies. Intensive efforts have been performed to link people over world at once. However, many technical and security difficulties still prevent the perfect linkage to be real.

During the last two decades, digital processing systems have exhibited high efficiencies in transferring visual data, such images and videos [1]. Meanwhile, converting to the high-definition configurations has imposed new understanding of visual data transfer that requires ultra-high efficient processing stages [2-4]. Such requirement makes processing systems in reasonable need to develop their designs, configurations, protocols and components [5]. Digital image processing may represent an application that add further requirement to the development process mentioned above.

Data transfer involves the reliable delivery of transparent data between the users. All data are delivered in sequence with no duplication or missing parts [6]. With normal response mode (NRM), a primary station initiates data transfer to a secondary station. A secondary station transmits data only in response to a poll from the primary station. This mode of operation applies to an unbalanced configuration [7]. With asynchronous response mode (ARM) a secondary station may initiate transmission without receiving a poll from a primary station. It is useful on a circuit where there is only one active secondary station [6]. The overhead of continuous polling is thus eliminated. Asynchronous balanced mode (ABM) is a balanced mode that provides symmetric data transfer capability between combined stations [8]. Each station operates as if it were a primary station, can initiate data transfer, and is responsible for error recovery. One application of this mode is hub polling, where a secondary station needs to initiate transmission [6].

Unacknowledged operation is applicable for point-to-point and broadcast information transfer. However, acknowledged operation is applicable only for point-to-point information transfer [9]. There are two forms of acknowledged information that are defined: Single-frame operation (SFO); and Multiframe operation (MFO) [6].

In order to perform efficient transfer of visual data over long distances and different environments at the minimum losses and imperfections those may be imposed on the transferred data, it was proposed to convert the main frame of the configuration over which the data are distributed into many smaller frames each contains some of the original data with the same modulation and restoration characteristics [10-13]. This could be performed by multi-stage processing protocols that impose much more costs and explicit complications on the communications systems [14]. Alternatively, a single-stage processing can be performed at lower costs as well as fewer transfer stages with some modifications on the original data those could be recognized and reversed at the reception terminals with sufficiently high efficiency [15].

In this work, a multiple coded frame temporal processing is proposed as a protocol to enhance the digital image processing in digital communications systems. This protocol is based on the dissembling of visual data packages into multiple coded frames and transmitting them over secured temporal route.

2. Modelling Equations

It is well-known that the resolution of a digital image is determined by its pixel counts, horizontal and vertical [6]. Digital images are usually treated as matrices over which the data are distributed. Therefore, coding process can be relatively easy at the stage of design and configuration of the digital communications system [16]. However, several difficulties such as attenuation and phase distortion, deformation, counterfeiting and spoofing are highly possible at one or more stages of transfer stages [17,18].

Attenuation distortion can be avoided if all frequencies within the passband are subjected to the same loss (or gain). Whatever the transmission medium, however, some frequencies are attenuated more than others. Filters are employed in most active circuits (and in some passive circuits) and are major causes of attenuation distortion [6,11]. When filters or filter-like devices are placed in tandem, attenuation distortion tends to sum. Two identical filters degrade attenuation distortion twice as much as just one filter [6].

Phase distortion has little effect on speech communications over the telecommunications network [19]. However, regarding data transmission, phase distortion is the greatest bottleneck for data rate (i.e., the number of bits per second that a channel can support). It has probably more effect on limiting data rate that any other parameter [6].

Older pulse code modulation (PCM) systems used a 7-bit code, and modern systems use higher-bit code with its improved quantizing distortion performance [20]. The companding and coding are carried out together, simultaneously. The compression and later expansion functions are logarithmic [12]. A pseudologarithmic curve made up of linear segments imparts finer granularity to low-level signals and fewer granularities to the higher-level signals [6].

An integral equation is proposed to convert such matrices into multiple frames with the same content but different distribution of data over the total frame of the matrix as

$$D=\frac{1}{\delta}\int_0^n\int_0^m\frac{K(1-\delta^2)}{4\pi\rho}\partial m\partial n \quad (1)$$

where D is the transfer rate, δ is a conversion parameter of the total frame into multiple smaller frames, K is a restoration constant, which depends on the size and dimensions of visual data to be transferred and the type of modulation performed on these data before transmission, ρ is the dissembling parameter, and finally, m and n are the dimensions of the matrix over which the visual data are distributed

This formula is sufficiently applicable in 720dpi visual coding and communications systems. However, it may need for some corrections to satisfy the requirements of high-definition networks [4]. Therefore, the previous equation was corrected as follows

$$D=\frac{2}{3\delta}\int_0^n\int_0^m\frac{K(1-\delta^2)}{4\pi\rho}e^{-i(1-\delta^2)\tau}\partial m\partial n \quad (2)$$

The exponential term can be trigonometrically or numerically expanded to show more choices in practical environments. Therefore, the equation (2) can be written as

$$e^{-i(1-\delta^2)\tau}=cos[(1-\delta^2)\tau]-isin[(1-\delta^2)\tau] \quad (3a)$$

or

$$e^{-i(1-\delta^2)\tau}=1-i(1-\delta^2)\tau+\frac{\left(-i(1-\delta^2)\tau\right)^2}{2!}+\frac{\left(-i(1-\delta^2)\tau\right)^3}{3!}+\cdots \quad (3b)$$

From both formulae, only the real parts – those should be equal – can be considered as

$$cos[(1-\delta^2)\tau]=1-\frac{\left((1-\delta^2)\tau\right)^2}{2!}-\frac{\left((1-\delta^2)\tau\right)^4}{4!}-\frac{\left((1-\delta^2)\tau\right)^6}{6!}-\cdots \quad (3c)$$

Recalling that the Fourier transformation of the cosine function is given by:

$$cos[(1-\delta^2)\tau]=\frac{1}{2}\sqrt{\frac{\pi}{\tau}}sin\left(\tau+\frac{\pi}{4}+\frac{\omega^2}{4\tau}\right) \quad (3d)$$

and approximating the left side to the first two terms, as the higher-order terms are vanishing, we obtain

$$\frac{1}{2}\sqrt{\frac{\pi}{\tau}}sin\left(\tau+\frac{\pi}{4}+\frac{\omega^2}{4\tau}\right)=1-\frac{\left((1-\delta^2)\tau\right)^2}{2!} \quad (3e)$$

This equation will be examined as an alternative to Eq. (1) for practical purposes.

3. Result and Discussion

In order to examine the validity and applicability of Eq. (3e), we have chosen a high-definition digital image, as shown in Fig. (1), and applied the condition given by Eq. (3e) at different values of τ, δ and ω as shown in table (1). Results are shown in figures (1b-j) in accordance to the fundamental formula (Eq. 1).

Table (1) Values of parameters in Eq. (3e) in accordance to the fundamental formula (Eq. 1) for the processed example image

No.	τ (ms)	δ (s^{-1})	ω (rad^{-1})
1a	0.01	1	1000
1b	0.05	10	10000
1c	0.1	100	100000
1d	0.01	10	10000
1e	0.05	100	100000
1f	0.1	1	1000
1g	0.01	100	100000
1h	0.05	1	1000
1i	0.1	10	10000
1j	0.1	100	10000

(a)

(b)

(c)

(d)

(e)

(f)

(g)

(h)

(i)

(j)

Fig (1) Application of Eq. (3e) conditions on a digital image in accordance to the fundamental formula (Eq. 1) as (a) is the original image

It is clear from Fig. (1) that there are some conditions to reconfigure the received image – as visual data – with high coincidence to the original (transmitted) one. For example, for values of τ=0.1 ms, δ=100 s^{-1} and ω=10^5 rad^{-1}, the received image (1c) has high quality with relatively low distortion over the total area of distributed data. This distortion was decreased for the image (1j) with values of τ=0.1 ms, δ=100 s^{-1} and ω=10^4 rad^{-1}, which may be attributed to the lower rate of transferring these data, which in turn enhances the reconfiguration of the received data as longer time is available for each element to transfer and find its identical position on the matrix of the data distribution on reception terminal.

4. Conclusion

A multiple coded frame temporal processing is proposed as a protocol to enhance the digital image processing in digital communications systems. This protocol is based on the dissembling of visual data packages into multiple coded frames and transmitting them over secured temporal route. Data transfer involves the reliable delivery of transparent data between the users. All data are delivered in sequence with no duplication or missing parts Three main parameters were controlled in order to examine the proposed protocol and its applicability to enhance the quality of digital image at the reception stage.

Reference

[1] D.J. Kadhim, S.A. Abdulhussain, B.M. Ridha and A.M. Abbas, “A Balanced Backoff Algorithm for IEEE802.11 Wireless Network”, *Iraqi J. Appl. Phys.,* 8(1), 27-33.
[2] R. Cole and M. McFarlane, “Enhancement of Digital Images by SuperSense Algorithm”, *J. Prog. Digit. Commun.*, 11(1) (2005) 37-42.
[3] J.K. Ali and N.N. Husain, “A New Fractal Microstrip Bandpass Filter Design Based on Dual-Mode Square Ring Resonator for Wireless Communication Systems”, *Iraqi J. Appl. Phys.,* 5(1), 9-14.
[4] E. Talbot, F. Richardson and J. Kane, “Fourier Transformed Integral Filter for Digital Image Transfer”, *J. Prog. Digit. Commun.*, 13(2) (2007) 141-148.
[5] B.S. Mahdi and A.K. Abdul Hassan, “A Novel Secure Digital Watermark Generation from Public Share by Using Visual Cryptography and MAC Techniques”, *Iraqi J. Appl. Phys.,* 10(3), 3-9.
[6] R.L. Freeman, **“Fundamentals of Telecommunications”**, John Wiley & Sons, Inc. (NY) (1999), p. 48, 50, 117, 294, 295, 365, 416.
[7] B. Jonson, I. Pavlov, M. Vasliev and A. Gorechenko, “Efficient Model to Enhance Digital Image Processing for High-Definition Applications”, *J. Prog. Digit. Commun.*, 19(3) (2013) 201-226.
[8] A.K. Humady and H.K. Chaiel, “Classification of Digital Modulation Using Wavelet Transform”, *Iraqi J. Appl. Phys.,* 1(3), 15-21
[9] A. Tassoti, L. Girlo and G. Panzini, “Modification of Digital Image Processing Formula Based on Dual Frame Configuration”, *J. Prog. Digit. Commun.*, 15(4) (2009) 13-22.
[10] S.S. Jassem, “Comparative Evaluation of Bit Error Rate in Frequency Selective Fading Channels Employed in Wavelet Modulation”, *Iraqi J. Appl. Phys. Lett.,* L1(2), 14-19.
[11] I. Norman, H. Larson, O. Cardoso, M. Lancer, H. Jacobson, U. Kabonga and L. Zakharaova, “Multiple-Frame Configuration of EEDJSCs for High-Definition Communications”, *Euro. J. Electron. Digit. Commun.*, 8(4) (2016) 39-48.
[12] H.M. Abdul Jabar and M.I. Malik, “Determination of The Satellite Images Orientation Using DCT Coefficients”, *Iraqi J. Appl. Phys.,* 6(2), 31-34.
[13] E.H. Ibrahem, “FSK Transceiver for Bit Error Rate Tester Implementation”, *Iraqi J. Appl. Phys.,* 8(4), 9-16.
[14] M.N. Raheema, H.A. Nasir and A.K. Nahier, “Performance Optimizing of Fourth Order Delta-Sigma Fractional-N Frequency Synthesizer using a Dither Technique for Third Generation (3G) Applications”, *Iraqi J. Appl. Phys.,* 7(1), 3-9.
[15] O. Cardoso, M. Lancer, H. Jacobson, I. Norman, H. Larson, U. Kabonga and L. Zakharaova, “Ultrafast Conversion of Main-Frame Configurations into Multiple-Frame Configuration Digital Image Transfer”, *Euro. J. Electron. Digit. Commun.*, 8(6) (2016) 327-336.
[16] A.K. Abdul Hassan, “Reliable Implementation of Paillier Cryptosystem”, *Iraqi J. Appl. Phys.,* 10(4), 27-29.
[17] E.H. Ibrahem, N.Q. Mohammed and H.M. Dawood, “Software Defined Radio (SDR) Methodology Based Multi–Core Software Platform”, *Iraqi J. Appl. Phys.,* 9(4), 3-9.
[18] P.E. Sterian, “Synchronization Scheme for Secured Communications System Based on Chaotic Signals”, *Iraqi J. Appl. Phys. Lett.,* L3(1), 7-10.
[19] A.Kh. Al-Asmari, “Transmission of Compressed Video Signals through Spread Spectrum Channel”, *Iraqi J. Appl. Phys.,* 6(4), 9-16.
[20] H.M. Azzawi, “A Method to Improve the Security Level of Advanced Encryption Standard Algorithm by Using Proposed Algorithm”, *Iraqi J. Appl. Phys.,* 8(4), 29-32.