International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Secure Fiber Optic Communication System based on Wavelength Coding

Mohammed A. Hamzah[1], Basher Mohamad Husen[2]

[1]Department of Physics, College of Science, University of Baghdad, Baghdad, Iraq
Corresponding Author Email: *moh4691[at]gmail.com*

[2]Department of Physics, College of Science, University of Baghdad, Baghdad, Iraq

Abstract: ***Optical fiber communication system is successfully implementation and secured by wavelength-coding method. The modulation is deferent form the usual modulation method such as Frequency Modulation FM or Amplitude Modulation AM. Depending on the logic state of transmitted digital data the wavelength of transmitted light will be changed from one 535nm to 525nm when the digital information changed from logic state 0 to logic state 1 and verse versa. The received lights are analysis to process a wavelength decoding and get back of the original transmitted digital information.***

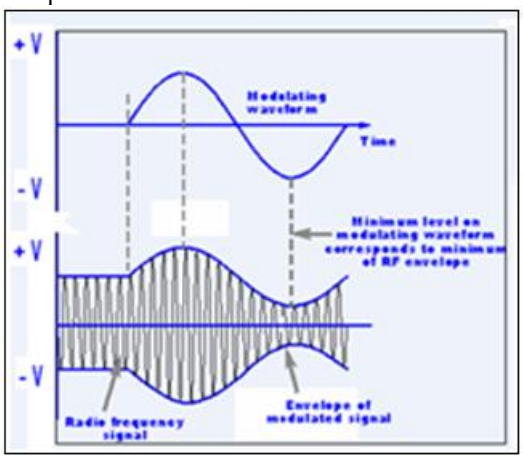
Keywords: wavelength-coding, spectrophotometer

1. Introduction

Benefits of Optical fiber systems have many advantages such as; Long-distance signal transmission, large bandwidth, low attenuation and small diameter. Several techniques of light modulation have been used in the fiber optic communication system such as amplitude modulation (AM), frequency modulation (FM). Figure (1) and Figure (2) demonstrate the amplitude modulation (AM), frequency modulation (FM) respectively [1-7].

In present work, a deferent modulation technique based on wavelength coding has been proposed; this technique converts the digital form to light wavelength varying. Therefore, the digital form equal (0) is converted to 535 nm while the digital form equal (1) is converted to 525 nm and verse versa.

A) RF Amplitude Modulation



B) Light Amplitude Modulation

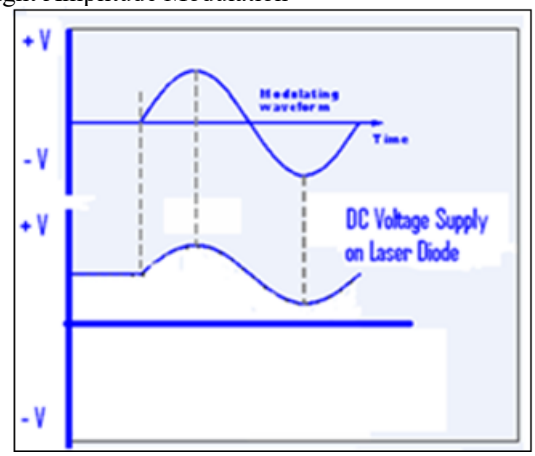
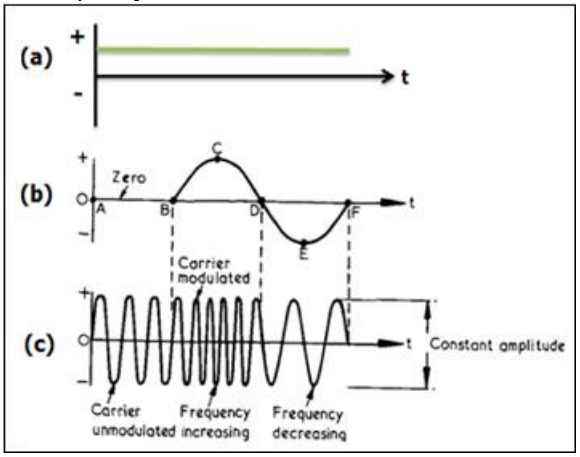


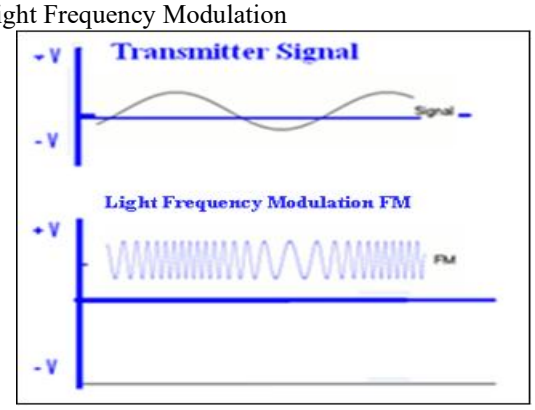
Figure 1: Forms of Amplitude Modulation AM (A) RF Amplitude Modulation (B) Light Amplitude Modulation

A) RF Frequency Modulation FM



(A)

B) Light Frequency Modulation

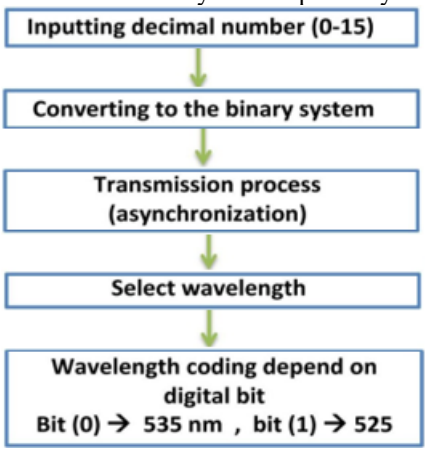


(B)

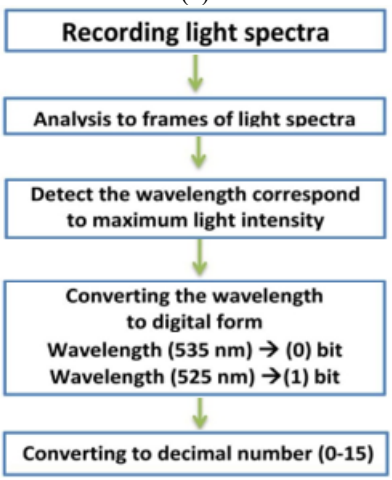
Figure 2: Forms of frequency Modulation FM (A) RF Frequency Modulation (B) Light Frequency Modulation

2. Experimental Work

Shimazu spectrophotometric RF-551 has been used as optoelectronics transmitter device, the Diffraction grating angle is controlled by Arduino Mega 2560 microcontroller to select the requirement wavelength depend on the logic state of transmitted digital data. The portable spectrophotometer type Surwit S300-UV-NIR is used as optoelectronics receiver device. Figure (1-a) and (1-b) show a schematic diagram for whole process which done in the transmitter stage and receiver stage of the communication system respectfully.



(a)



(b)

Figure 3: Illustrate the schematic diagram for whole process of communication system, (a) transmitter stage and (b) receiver stage.

In transmitter stage the decimal numbers (0- 15) is firstly convert to the binary system and get a 4 bits (decimal number → 4 bits). According to asynchronization transmitted method, the start, stop bit and parity chick are add to the 4 bits. So the decimal number is representing by 7 bits. Later the 7 bits is convert from parallel data to serial data, then each serial bits is transmitted as a light with specific wavelength (bit (0) → 535 nm, bit (1) → 525nm). At last, the light with wavelength coding is transmitted through fiber optics to the receiver stage.

In the receiver stage, special programs written in visual Basic is use to records the received light spectra and make image processing to the frames of received spectra. The goal of image process is to process each frame and get the wavelength corresponds to the light with high intensity. The next step is done by run decoding process subroutine which convert values of wavelength to the digital form (535 nm →bit (0) , 525nm → bit (1)), then parity check is following this step. Finally, 4 bits are collected then convert to decimal form. Actually, the decimal form is representing to the original transmitted decimal numbers.

3. Results and Analysis

Figures (4) and (5) shows the transmitted light spectra after wavelength coding process for decimal numbers 0 to 15, the spectra is recorded with help of visual basic program and plotted with help of MATLAB program. It has clearly seen that each transmitted bits stream consists the decimal number represented by 4 bits with start, party check and stop bits. Also one could clearly see that the light intensity is fixed and the light wavelength is varying from the wavelength 525nm to 535nm when logic of transmitted bit varying from 0 to 1 and vice versa.

Figures (6) to (7) shows the results from image processing on the frames of received spectra, her each frame convert to one value which represent to the wavelength corresponds to the light with high intensity get. While the Figures (8) and (9) shows the results from wavelength decoding process, these process convert the values of wavelength to the digital form (535 nm →bit (0), 525nm → bit (1)). Finally, when the parity check is OK the 4 bits are extracts and convert to decimal form, the decimal form is representing to the original transmitted decimal numbers.

One could strongly noted that each decimal number are successfully coded and decoded by wavelength coding process.

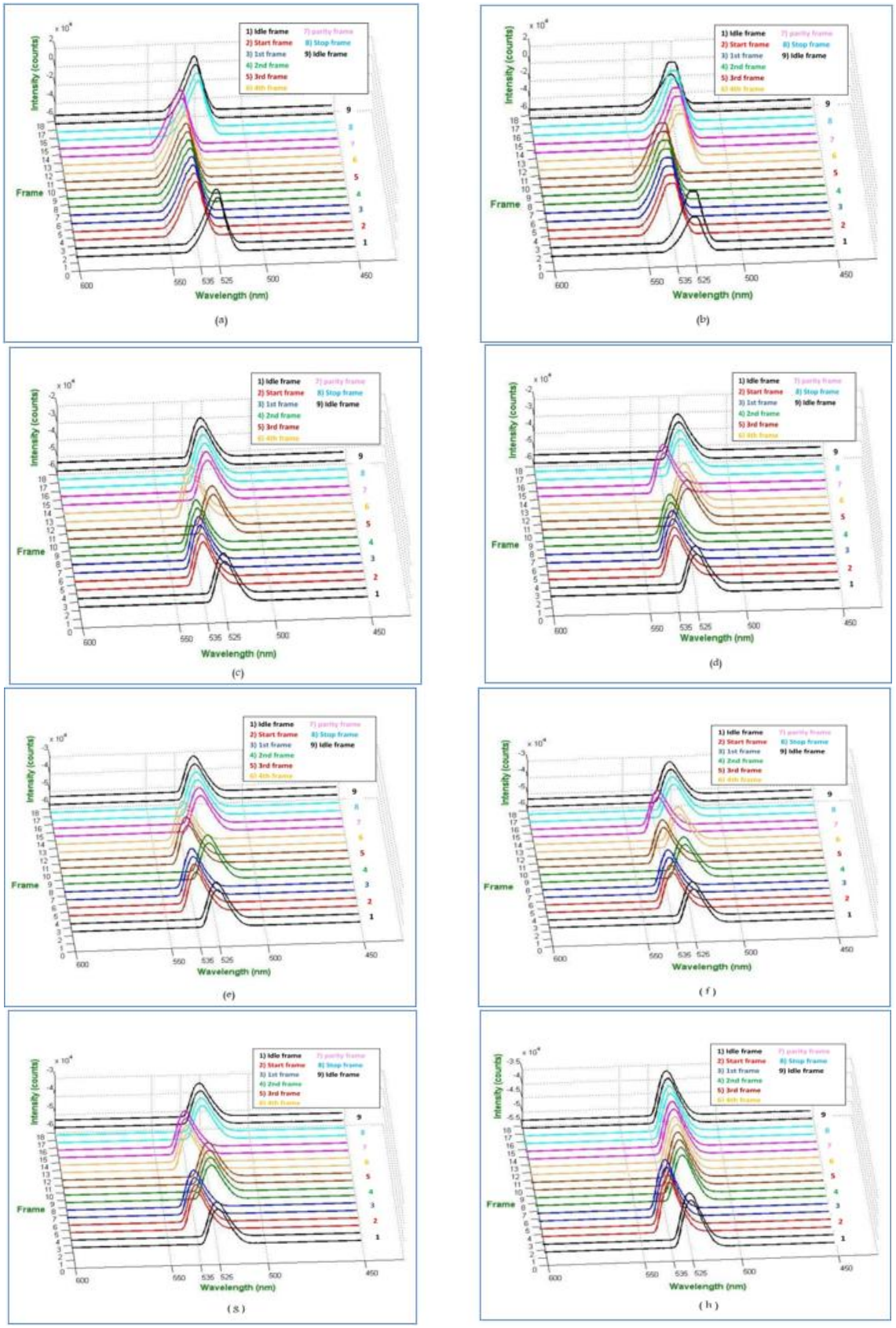


Figure 4: Shows the light spectra after wavelength coding process; a) for decimal 0, b) for decimal 1, c) for decimal 2, d) for decimal 3, e) for decimal 4, f) for decimal 5, g) for decimal 6, h) for decimal 7

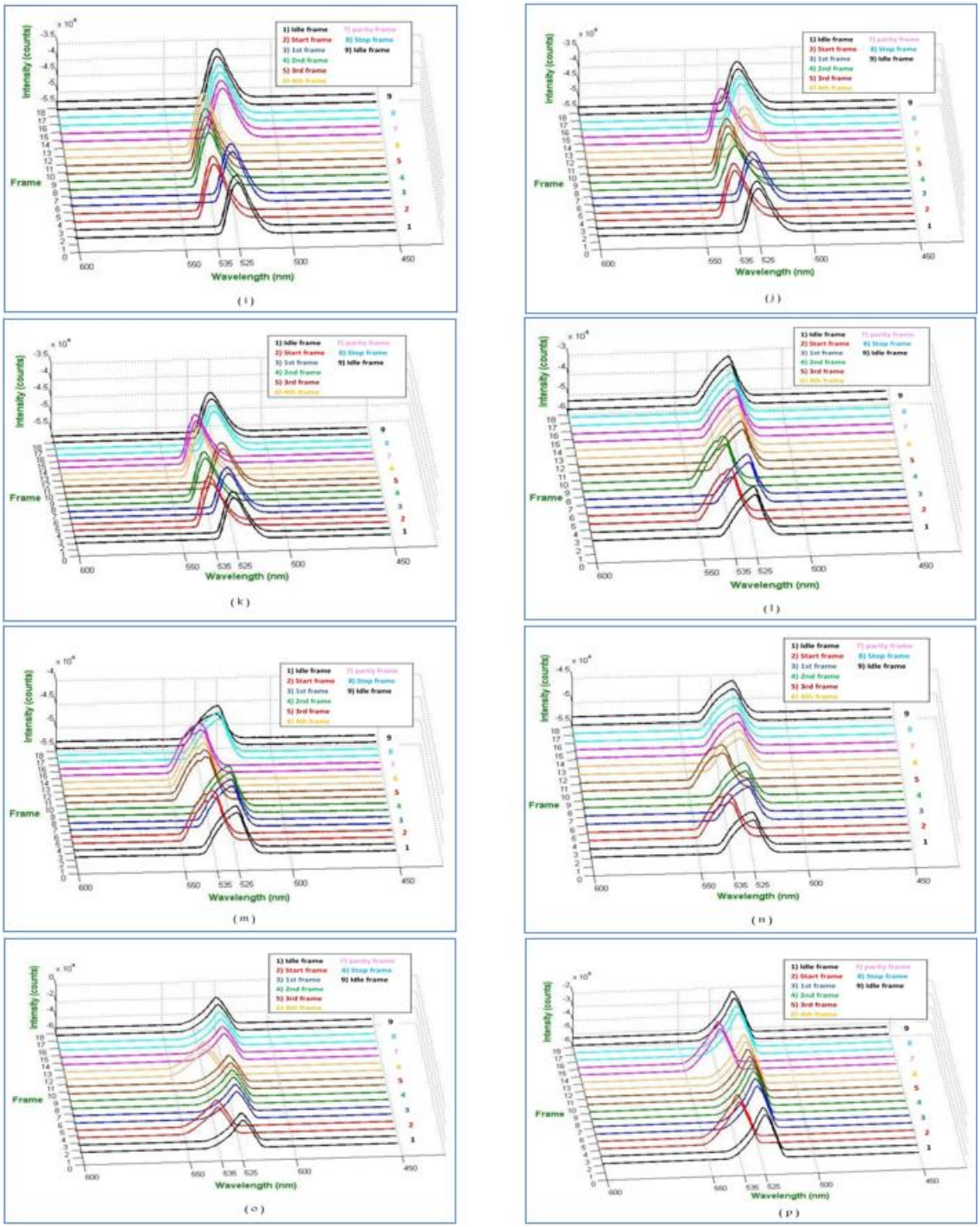
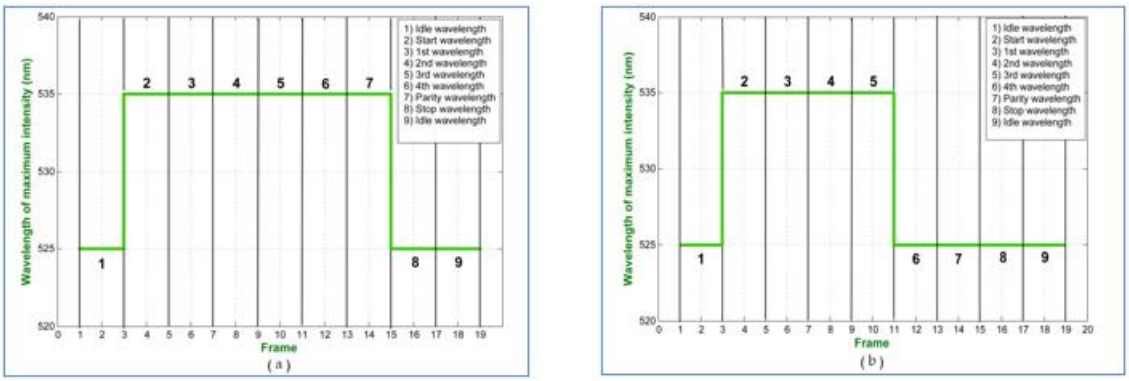


Figure 5: Shows the light spectra after wavelength coding process; i) for decimal 8, j) for decimal 9, k) for decimal 10, L) for decimal 11, m) for decimal 12, n) for decimal 13, 0) for decimal 14, p) for decimal 15.



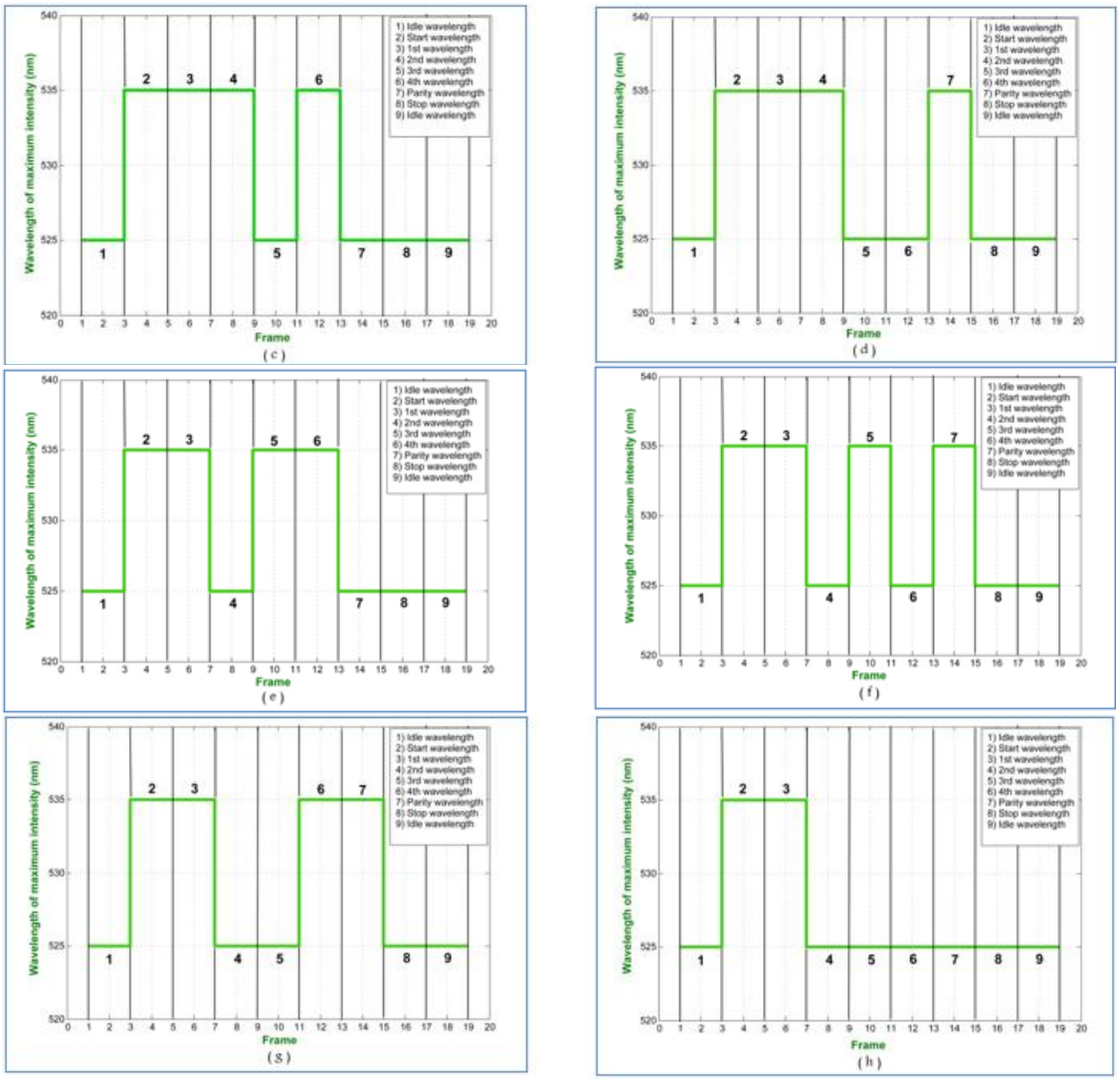
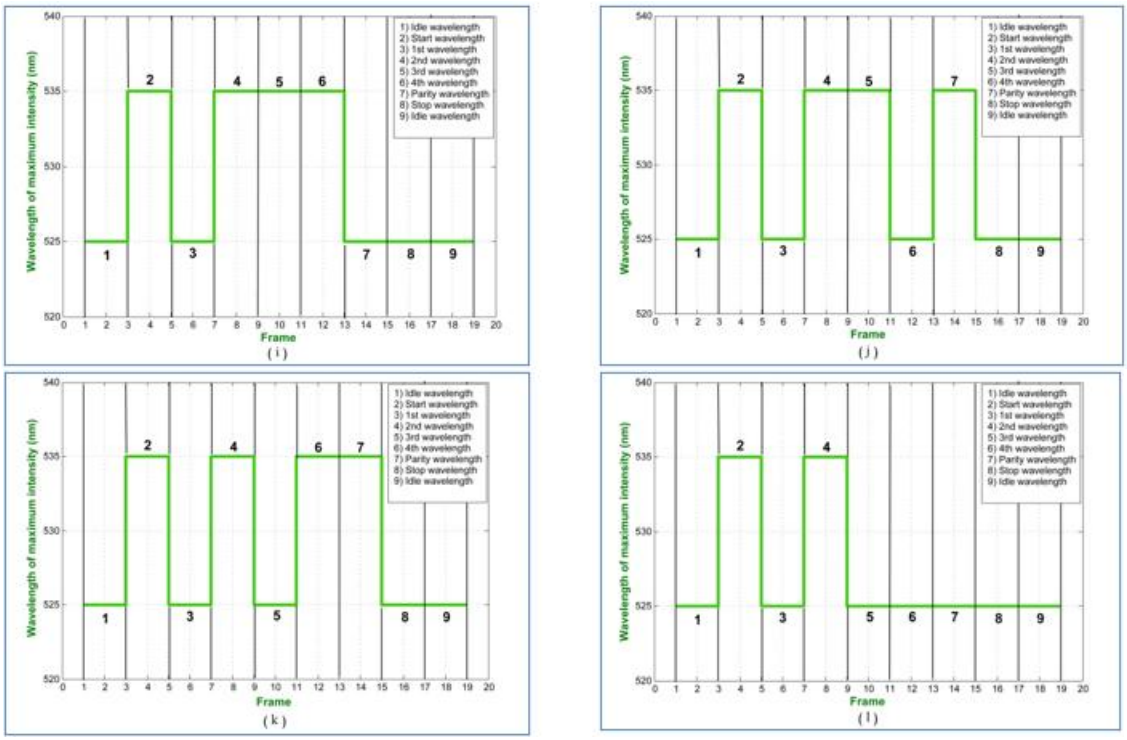


Figure 6: Shows the results of image processing on the frames of received spectra a) for decimal 0, b) for decimal 1, c) for decimal 2, d) for decimal 3, e) for decimal 4, f) for decimal 5, g) for decimal 6, h) for decimal 7



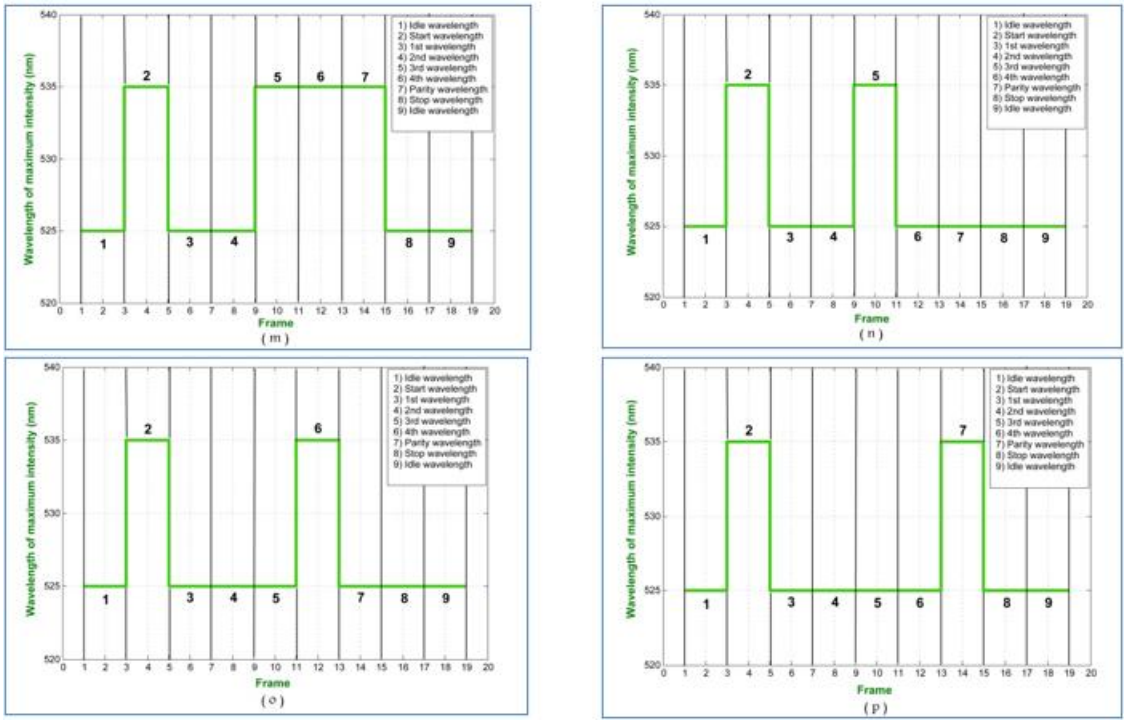
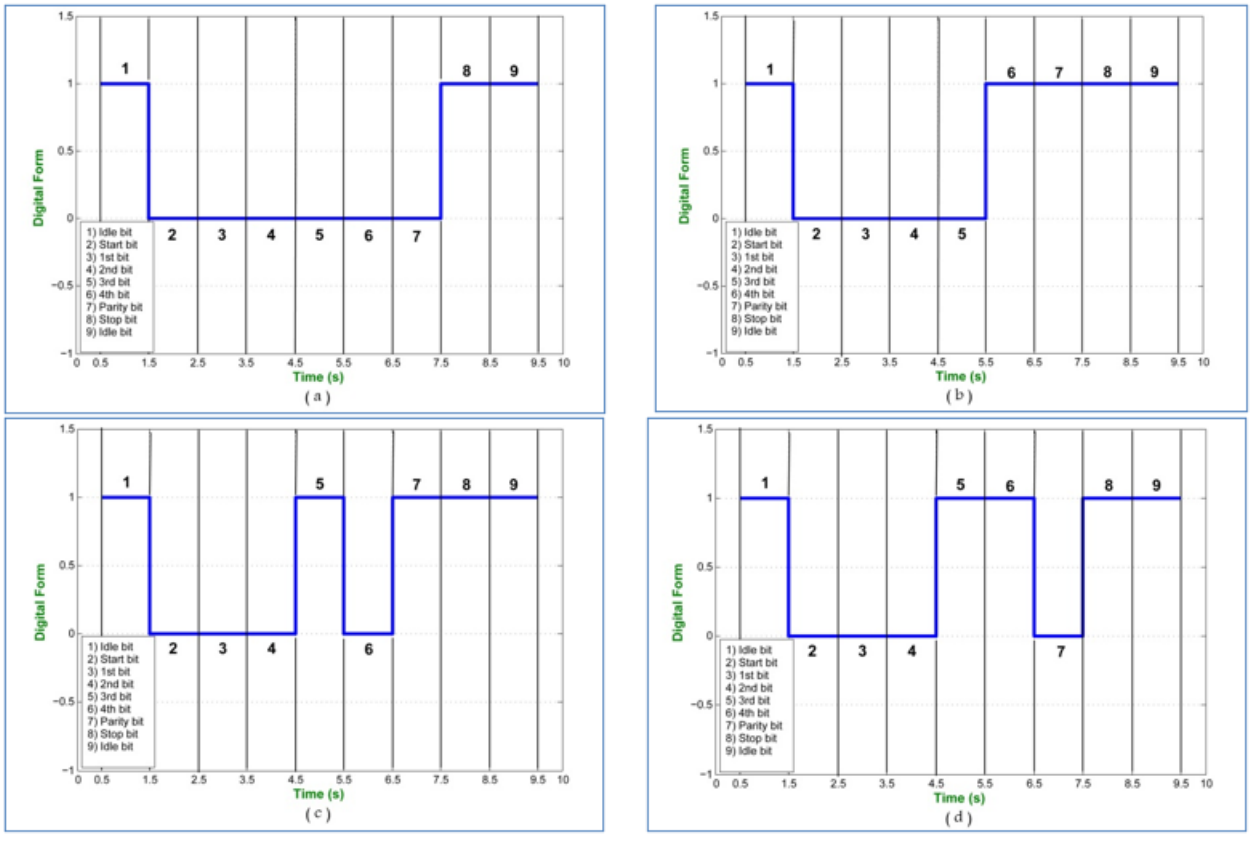


Figure 7: Shows the results of image processing on the frames of received spectra; i) for decimal 8, j) for decimal 9, k) for decimal 10, L) for decimal 11, m) for decimal 12, n) for decimal 13, 0) for decimal 14, p) for decimal 15



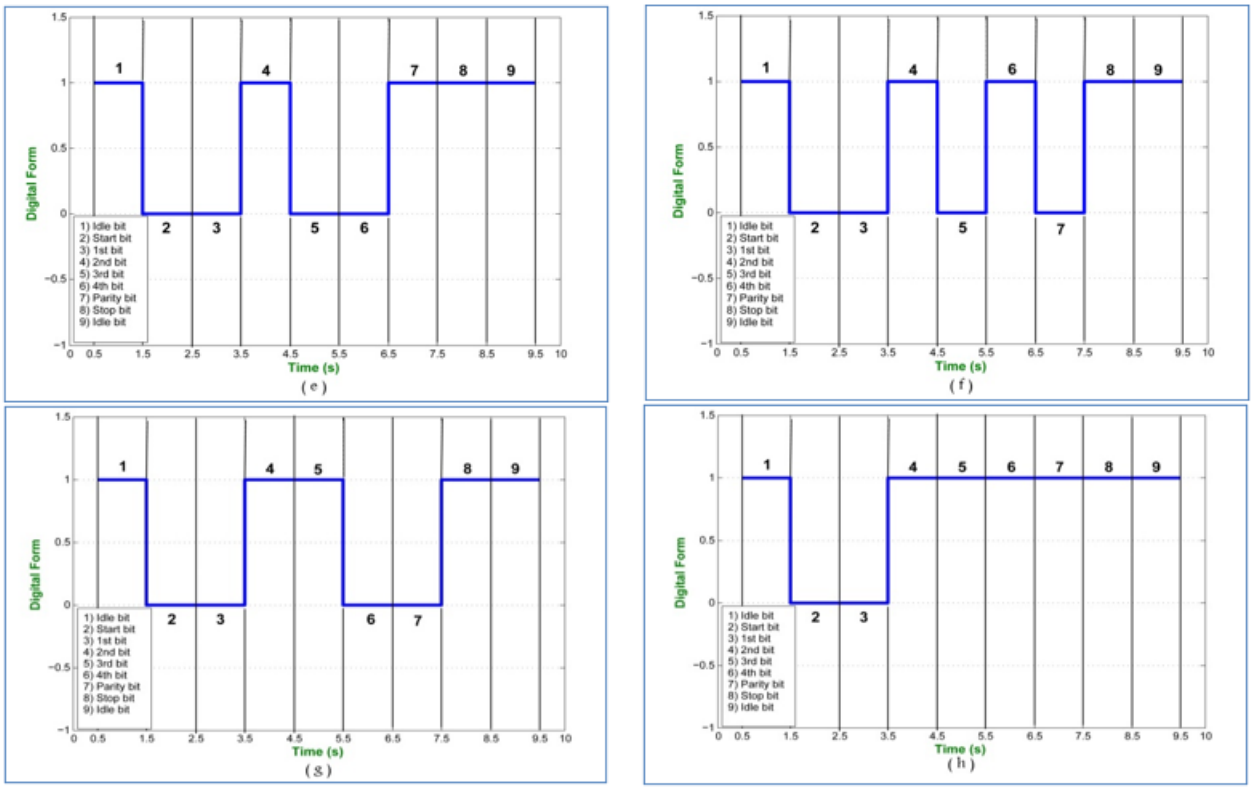
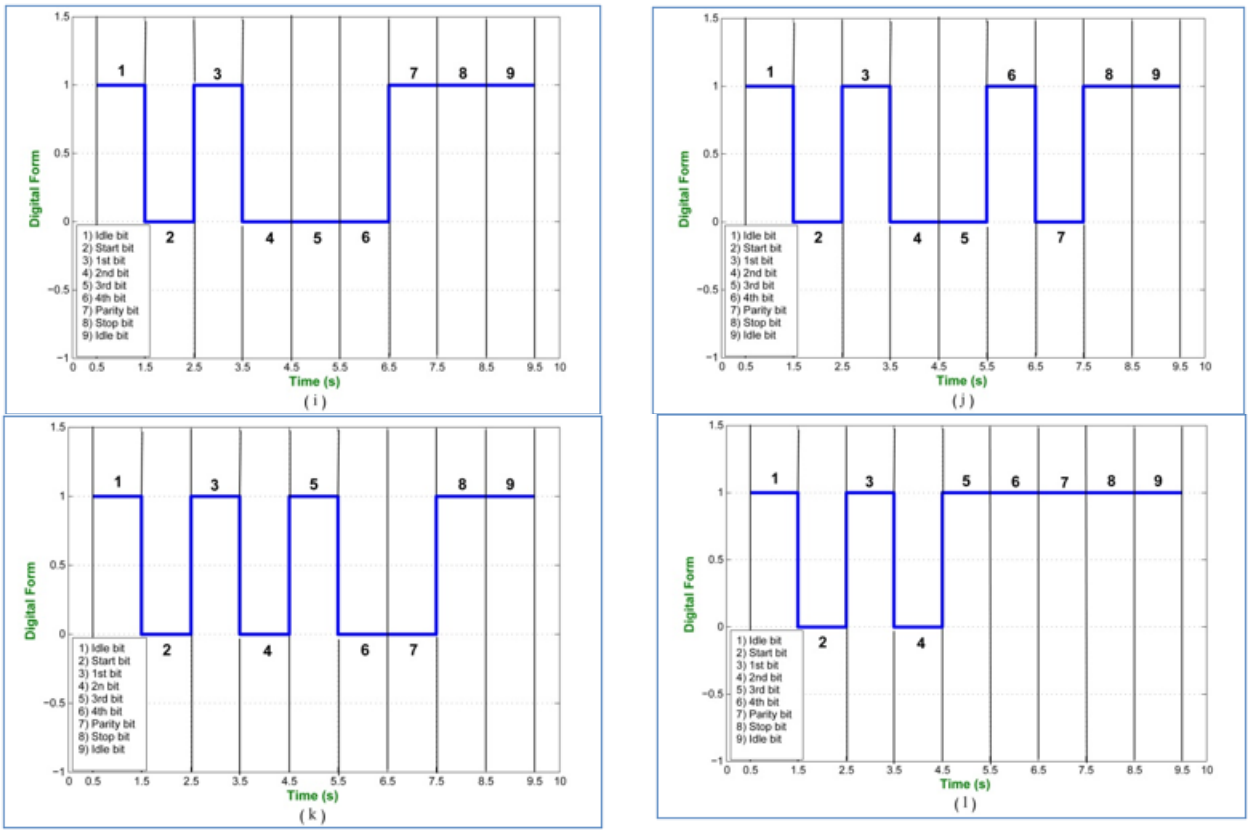


Figure 8: Shows the results of wavelength decoding process; a) for decimal 0, b) for decimal 1, c) for decimal 2, d) for decimal 3, e) for decimal 4, f) for decimal 5, g) for decimal 6, h) for decimal 7



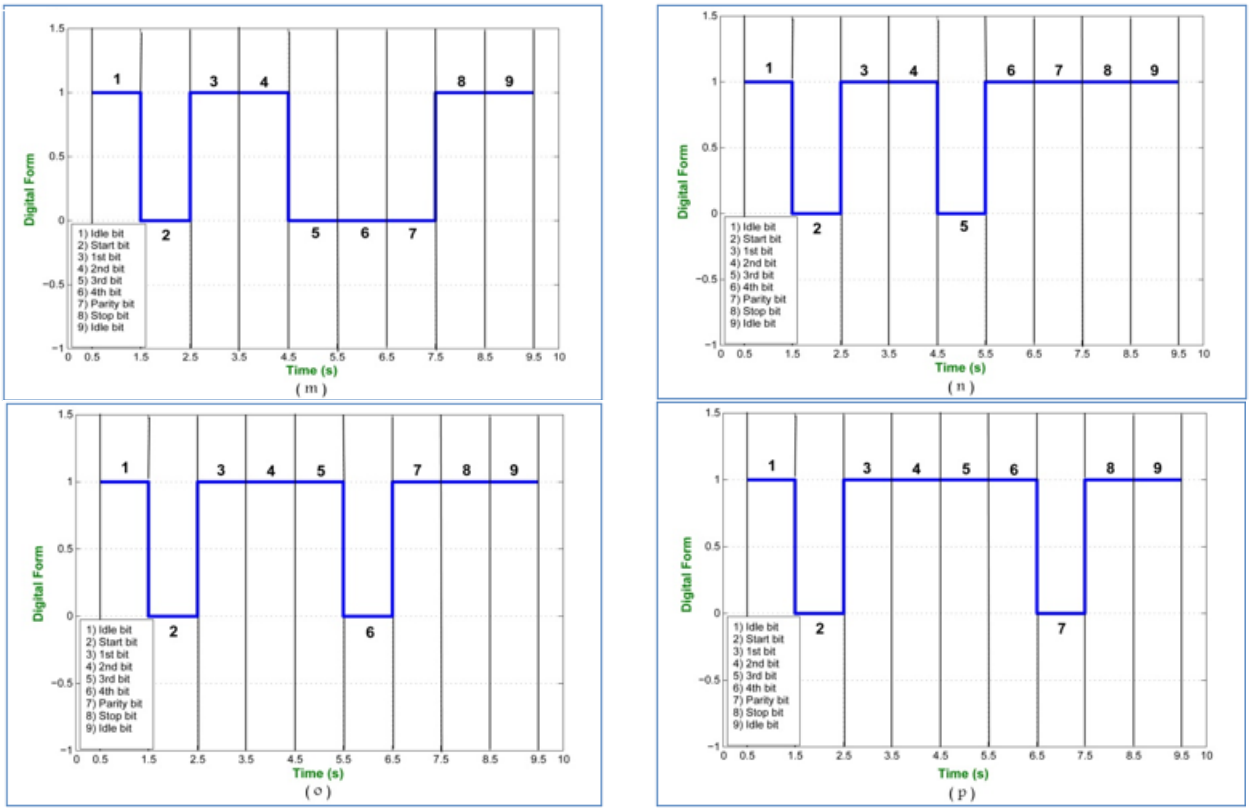


Figure 9: Shows the results of wavelength decoding process; i) for decimal 8, j) for decimal 9, k) for decimal 10, L) for decimal 11, m) for decimal 12, n) for decimal 13, 0) for decimal 14, p) for decimal 15.

4. Conclusion

Coding of fiber optics communication system is successfully done by wavelength coding process. The decimal numbers from 0 to 15 are successfully transmitted with wavelength coding method then decoded by same coding process, these results suggest that it could use wavelength-coding process with the fiber optics communication systems.

References

[1] Michael Bass, "Fiber Optics Handbook: Fiber, Devices, and Systems for Optical Communications", The McGraw-Hill Companies Inc., 2002, 1 edition
[2] Govind P. Agrawal, " Fiber-Optic Communication", John Wiley & Sons, Inc, 2002.
[3] Bill Woodward and Emile B. Husson, "Fiber Optics Installer and Technician Guide ", John Wiley & Sons, 2006.
[4] Simon S. Haykin, " Communication systems ", Wiley, 2001, 4th edition.
[5] P. Harvey & K.J. Bohlman, " Stereo F.M. Radio Handbook ", Norman Price Ltd, 1974.
[6] Safaa Alaa Eldeen Hamza1, Dr. Amin Babiker A/Nabi Mustafa2, " The use of Pulse Width Modulation "PWM" Technique in LED Lighting Systems ", International Journal of Science and Research (IJSR), Volume 3 Issue 11, 2014.
[7] Joel Sing, " modulation ", Data communication, 2008