Study the Magnetization of Water using Digital Camera and Laser beam

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Abstract
In this research, the magnetization of the water was investigated through the digital image processing technique of the laser spot after passing through magnetic water. This was done by using different magnetic fields and at different times. It was found that changes in the image of the laser spot are changes in the intensity of the pixel value of the spot image, i.e. the amount of attenuation in the amount of light illumination. The increased exposure time and field strength accelerated the intensity of pixel illumination, due to the rapid deposition of suspended substances in the water by shedding the magnetic field. This study found a new method for measuring the purity of water remotely using remote sensing technology and digital image processing. The laser spot image was studied and analyzed using different methods and software such as MATLAB, Image J, Curve Expert Professional and Origin lab 9.0, also The refractive index of normal water and magnetized water was measured using this technique. PH and the concentration of salts dissolved in water before and after magnetization were measured and compared between them using devices.

Keywords: Laser Physics, Image Processing, Magnetized Water.

Introduction

The laser imaging system is a new technology for remote sensing developed from laser and laser imaging. This is another way to detect information, regardless of visible light, infrared imaging and radar imaging. The technology uses high energy lasers as a light source to illuminate targets. Therefore, shooting is done by not touching the targets directly to obtain target images. Then, using laser images for objectives, the process of extracting information in the form of image analysis including the identification, identification and
confirmation of goals, and thus meet the requirements to obtain real-time targeted information in high accuracy and multiple dimensions and high efficiency. [1]

**Laser physics** Lasers are currently used for multiple purposes and in many different fields of scientific and technical research, including natural sciences such as physics, chemistry, and life sciences as well in medicine, industry, the world of electronics, and military uses, etc. [2]

LASER is a word abbreviation for Light Amplification by Stimulated Emission of Radiation, which is known as an electromagnetic beam whose photons are equal in frequency and identical in the waveform where interference between Directed into a high-energy, high-frequency photovoltaic pulse with a very small diffraction angle. [3]

The wavelength of the laser light is extremely pure compared to other light sources and all the photons that form the laser beam have a fixed-phase relationship with each other. Fig. (1) shows that electromagnetic radiation is emitted whenever a charged particle loses its energy, such as an electron.

**Image Processing** is the one of the important areas in computer science that deals with certain operations on digital images in order to improve, analyze and extract information from them, representation of two-dimensional images. The digital images consist of rows and columns of pixels (Pixels) The higher the number of pixels, the greater the resolution of the image. Digital image processing is used in various fields, including improved image information for easy understanding and interpretation of human beings, data processing for
storage purposes on different media, image transmission and automatic image recognition without the help of Human beings such as mechanical control, robot, etc. [4]

Some statistical measures to describe digital images:

- **Mean of Image**

Is the intensity of gray scale images If the image is gray in size between (0 - 255) the value closest to zero means that the image is close to darkness and that the value close to (255) means that the image is close to the brightness.

\[
\text{Mean (} \mu \text{)} = \frac{1}{M \times N} \sum_{m=1}^{M} \sum_{n=1}^{N} p(n, m)
\]  

Where: (p) the intensity value, n and m represent the rows and columns respectively.

- **Standard Deviation of Image**

Is the expression (degree of contrast of the image) which is one of the important characteristics in digital image processing, It depends on two factors:

1. Difference in the amount of radiation reflected from the forms.
2. The amount of exposure to light and the solutions used to display images.

High contrast images indicate large differences in gray levels, changes (large image density), and low-contrast images (small differences in gray levels and small changes in image density).

- **Histogram of Image**

The histogram of the image is as follows: Axis X represents the gray levels of images as they fall (The range is between 0 - 255) and the Y axis: Represents the duplicates of pixel elements. The repetitive distribution format helps us to determine image properties such as Brightness, Low or High Contrast, In which the image units are used, and the digital
images are loaded to determine the symmetry of the frequency distribution curve of the
image (i.e. positive, negative or symmetrical torsion), and also using kurtosis in digital
images to compare the deviation of the peak of the frequency distribution curve from the
natural curve) Flat, tapered or mild). [5]

Theory:

Magnetized water is known as water obtained after passing through a specific magnetic
field or by placing the magnet inside or near the water for a period of time, there by
changing some of its properties. [6]

When water is exposed to the magnetic field, its properties change to become more
granular and energetic, Magneto Biology considered the birth of a new science of bio
magnetism, and proved its many benefits in marketing. [7] The salt molecules such as
calcium and magnesium in water tend to form random bonds between them during their
irregular movement in water. When these bonds become too large to concentrate more than
the solubility of these sediments, they are deposited on the inner walls of the conveying
pipes. Water, the magnetic field regulates the movement of these molecules to prevent the
formation of these bonds and thus prevents the formation of salt deposits.

The most important factors that depend on the success of a magnetic transaction are: [8]

1. Magnetic field strength
2. The time of exposure
3. Orientation vertically on the water jars

Many chemical and physical properties of water change when exposed to the magnetic
field for a sufficient period of time, including electrical conductivity and hydrogen number
due to the influence of the magnetic field in the form of the angle between the hydrogen
and oxygen atoms in the water molecules to 103 degrees and meet in small particle groups
Improved water absorption through living cell walls. [9]

Methodology:
This study relied on the use of a digital camera with an easy arithmetic system to detect the behavior of a laser beam when passing through a liquid medium. This section includes the study phases of two types of question normal water and magnetic water has been divided work into two main parts:

1- Creating an imaging system for the spot of the laser beam when passing through the liquid medium and taking images for laser spot of the different cases.

2- Application of image data processing on different liquid media in order to extract information from them.

The diagram below shows the steps of work and is shown in Fig. (2)

![Diagram](image.png)

**Figure 2: A diagram showing the steps of work**

**The samples of media:**

- **Water sample system**

The work system shown in Fig. (5) is composed of the following parts:

1. The source of the wavelength (632.8nm) helium-neon laser beam.
2. Glass basin dimensions (28*28 cm) bottle thickness 6mm.
3. A white screen

4. Nikon D3300 digital camera with 18-55mm lens with a resolution of up to 24.2 megapixels and sensor (CN05 = 23.5 * 15.6mm) that allows for detailed shooting and good performance even in low or low light conditions. ISO sensitivity in the camera up to ISO = 12800

5. The right amount of normal water

![Figure 3: Demonstrates parts of the working system](image)

The working system was prepared as in Fig. (3) The distance between the source and the glass container of water (20cm) and the distance between the the glass container of water and the monitor (10cm) were then placed (10 liters) of normal water in the glass container of water, after which a laser beam was passed through the water taking into account its position during the middle of the center, the camera angle was fixed towards the monitor. The concentration of the dissolved salts was measured using a TDS device for more than
10 points within the same medium and taken to adjust it to ensure that the reading was not taken in an area that might be less or more concentrated at the moment of taking a picture.

- **Magnetic Water sample system**

1- The source of the wavelength (632.8nm) helium-neon laser beam.

2- Glass basin dimensions (28*28 cm) bottle thickness 6mm.

3- A white screen with a red spot when the laser beam falls on it

4- Nikon D3300 digital camera with 18-55mm lens with a resolution of up to 24.2 megapixels and sensor (CN05 = 23.5 * 15.6mm) that allows for detailed shooting and good performance even in low or low light conditions. ISO sensitivity in the camera up to ISO = 12800

5- The right amount of normal water.

6- Magnetic coil The intensity of his magnetic field is equal to 100 Gauss and A self-magnet, his power (100 & 200 Watt).

7- Power transformer and Air fan to cool the coil.

![Figure 4: Demonstrates parts of the working system of magnetized water is used as a medium through which the laser passes](image-url)
In this way, used two types of magnets (coil magnetic - normal magnet) at time intervals to obtain the magnetized water.

As in the case of normal water, we used the same previous measurements and fix the camera angle towards the screen and take a picture of the resulting spot during different magnetization times.

PH was measured using the device and the concentration of dissolved salts was measured using the TDS device for more than ten points within the same medium and taken the rate to ensure that the reading is not taken in an area that may be less or more concentration at the moment of taking the picture.

**Results and Discussion**

Water is an optically transparent, if not contaminated, medium that allows rays to pass through the different wavelengths within the visible spectrum, such as the helium neon laser beam. The effect of magnetization on the intensity of the laser spot was studied by taking pictures of the resulting laser spot after passing through the medium at regular times. As shown in Figure (5).

![Figure 5: six images of laser spot taken in different exposure time for magnetized water](image-url)
where these images were computerized and converted to data through the use of the Image j program and extracting the histogram (to find the highest intensity) by taking a rate of the highest 10 pixel Values from the top of the histogram [10] as in Figure (6).

![Figure 6: Histogram Extraction (to find the highest intensity)](image)

**Application of Curve fitting:**

It is the process of creating the best fit curve, or a mathematical function to predict unknown values, as well as finding an equation to approximate the straight line and curves that best fit a series of data points and exactly mean the relationship between two variables of algebraic equations. (Function or equation) and find the variables associated with this model [11].

Curve Fitting was also applied to the resulting data to describe experimental data theoretically, And we applied this method to find a relationship through which the
magnitude of the magnetization of water is expected by simply knowing the magnetization time with the magnitude of the magnetic field being proven and this can be used in several fields such as desalination of water once the magnetization time is known. Table (1) shows the intensity of the laser spot during regular times of magnetization of water and similar ones from Curve Fitting.

Table (1) The intensity of the laser spot during regular times of magnetization of water

| Time (min) | Intensity(a.u) | Intensity(fitting) |
|------------|----------------|--------------------|
| 0          | 184.5          | 185.87             |
| 5          | 195.8          | 194.29             |
| 10         | 205.6          | 200.71             |
| 15         | 207.9          | 206.24             |
| 20         | 214.4          | 213.56             |
| 25         | 219            | 217.98             |
| 30         | 225.9          | 226.41             |

We note from Table (1) that the intensity data resulting from the Curve Fitting application is close to the intensity data resulting from digital image analysis of the practical aspect. The conclusion of a diagram illustrates the relationship between the intensity of the laser spot and how much time in Figure (7).
Where we notice in Figure (7,8) the increase in intensity with the passage of time as a result of planktonic gears of various types, as well as a decrease in the attenuation of the beam due to the magnetization of water where the solid and suspended materials and large-sized granules of high density with magnetization are separated under the influence of gravity as for grains of low density are It has a sedimentation velocity and has a low
magnetization effect, as it remains suspended in water. The laser beam spread through the water suffers from scattering and absorption by the particles and suspended particles in it, as well as from reflection due to the transmission of the laser beam between two different media in density. Molecular dispersion occurs with a number of processes that may be flexible as energy exchange with the molecule does not occur or is inelastic where energy exchange occurs with the molecule and the samples taken from each source may differ greatly in their properties from another time or depending on the place collected in the sample.

As for water, it was observed that the attenuation was the greatest possible and this is due to the increase in the density of the medium and also the refractive index change, leading to a greater dispersion of the passing beam. This is consistent with previous research. [12]

Whereas, the equation resulting from the application of Curve Fitting, which describes the relationship between the laser spot intensity and time, is as follows:

\[ Y = a + (b^x) \]

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a = 189.2928, b = 121.0000

where as

Y: represents the intensity of the laser spot
X: represents time

a, b: polynomial constants and their values depend on the type of medium

Also, the salt concentrations of magnetic water were calibrated using the TDS device (this device is used to know the suitability of the water for drinking) and to know the percentage of dissolved salts at each image taken for the laser spot after regular times.

Curve Fitting was also applied and the conclusion of Table (2), which shows reading the TDS device at regular times and its results from Curve Fitting through the use of Curve Expert Professional.
Table (2) Reading the TDS device during regular times of magnetization of water

| Time (min) | TDS(ppm) |
|-----------|----------|
| 0         | 516      |
| 5         | 484      |
| 10        | 444      |
| 15        | 439      |
| 20        | 437      |
| 25        | 432      |
| 30        | 424      |

We also conclude a diagram showing the relationship between TDS reading and magnetization time, as shown in Fig. (9)

![Figure 9: The relationship between TDS and time (before using curve fitting)](image-url)
The equation describing the relationship between TDS device reading and the time resulting from the Curve Fitting application is as follows:

\[ y = ax + bx^2 + \cdots \]  

\[ a = 515.1515 , \quad b = -780.7503 , \quad c = -0.00006060 \]

Whereas, Y: represents the TDS reading

X: represents time

a , b , c : polynomial constants whose values depend on the type of medium

Where we notice in Fig. (9 , 10) the decrease in reading of TDS device at the passage of time as a result of the deposition of the materials due to magnetization. The TDS device provides a specific measure of the amount of dissolved ions but does not tell us the nature or ionic relationships. Additionally, the device does not provide information about specific water quality such as high hardness, salty taste or corrosion. Therefore, the TDS is used as a test to determine the overall quality of water.

By returning the previous steps to calculate the pH, we get the following results after collecting the data and applying the Curve Fitting to it, a table (3) was obtained:
Table (3) Reading the PH device during regular times of magnetization of water

| Time (min) | PH  |
|-----------|-----|
| 0         | 7.72|
| 5         | 7.73|
| 10        | 8.25|
| 15        | 8.30|
| 20        | 8.33|
| 25        | 8.36|
| 30        | 8.5 |

And the conclusion of the diagram that shows the relationship between pH and time, as in Fig. (11)

Figure 11: The relationship between PH and time (before using curve fitting)
We notice from Table (3) and from Fig. (11, 12) an increase in the pH due to water magnetization during regular time periods, and the following equation describing this relationship was obtained using the Origin Lab program.

\[ y = \alpha + \frac{\theta x^\eta}{\kappa^\eta + x^\eta} \]  

\( \alpha = 7.72304, \ \theta = 0.63529, \ \eta = 6.98529, \ \kappa = 7.91714 \)

Whereas,

Y: reads the PH device

X: time

\( \alpha, \theta, \eta, \kappa \): polynomial constants whose values depend on the type of medium
Refractive index

I studied the effect of magnetization of water on the refractive index of the helium-neon laser by using image processing technique.

By using a diffraction grating to measure the refractive index before and after the normal water magnetization And through the following equations [13]:

Bright fringes :

in air: $d \sin \alpha_1 = \lambda_1$

in water: $d \sin \alpha_2 = \lambda_2$

From geometry of the experimental system:

in air: $\tan \alpha_1 = x_1 / L$, in water: $\tan \alpha_2 = x_2 / L$

We can make use of approximation of small angles: $\sin \alpha = \tan \alpha$

So length of light waves:

in air: $\lambda_1 = \frac{d x_1}{L}$, in water: $\lambda_2 = \frac{d x_2}{L}$

Refractive index of water relative to air: $n = \frac{v_p}{v_w}$

where: $v_p = v \lambda_1$ (velocity of light in air)

$v_w = v \lambda_2$ (velocity of light in water)

Final value of refractive index of water relative to air:

$$n = \frac{\lambda_1}{\lambda_2} = \frac{x_1}{x_2} \quad (5)$$

In this method the distance between the spots was Calculated computerized as shown in the figure (13, 14)
According to our measurements, value of refractive index of magnetized water is 1.332. The value does not diverge much from values of normal water, that is 1.329.

This difference in refractive index is due to Magnetization of the water changes many of its properties due to exposure to the influence of these magnetic spectral fields, that the process of magnetization reorganizes the water charges correctly in a time when the shape of these charges is random in the regular water.
The next method is to add a quantity of visually activated substance to water, and we used here (glucose sugar - found in honey) to know the effect of magnetization:

We used MATLAB program to plot the laser spot intensity in the three states:

- Normal water
- Magnetic water
- Add the activated substance to the Magnetized Water

![Figure 15: Intensity distribution (3-D) of output laser spot for Normal water](image)

![Figure 16: Intensity distribution (3-D) of output laser spot for Magnetized Water](image)
In Figures 15, 16 and 17, the processing image of the output laser spot shows that the peak of intensity reduces with an increase in glucose concentration because of the rotation of the polarization plane of laser.

A liquid consisting of optically active substance and inactive solvent has been found to produce a cycle that is almost proportional to the amount of the current active substance. This has led to the very widespread use of polarized light in the industry as an accurate method for determining the amount of sugar (this benefit is in vivo diabetes testing to determine the sugar content in the blood), which is a visually active substance, in the presence of inactive impurities. A specific rotation or rotational capacity is defined as the rotation that results from a 10 cm column of liquid containing the active substance 1 gram per cubic centimeter of the solution [14].
Conclusion

This describes that it is possible to use digital image processing technique to find out the magnetization of water by studying a digital image of the laser spot passing through magnetized water, where a relationship has been found between the intensity of the pixel component of the image and the amount of magnetization of water, and a relationship has been established linking the intensity of attenuation and the magnetization amount with dependence on the intensity Magnetic field and field exposure time.

Also, we were able to measure the refractive index with this technique by the distance between the spots was Calculated computerized.

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