ETHIOPIAN INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

eISSN: 2349-5715 pISSN: 2349-5707

Volume: 11, Issue 06, June-2024 SJIF 2019: 4.702 2020: 4.737 2021: 5.071 2022: 4.919 2023: 6.980 2024: 7,662

DIGITAL HOLOGRAPHY

Jumaeva Rano Toychi qizi
Termiz State Pedagogical Institute Faculty of Mathematics and Informatics
Teacher of the department "Mathematics and its teaching methods".
rjumaeva2024@gmail.com phone: +998912389908

Annotation. Digital holography is a method of recording 3D data using digital cameras. Today, it has a wide range of practical applications, and in the future, according to scientists, it will be indispensable in a number of fields, from medicine to astronomy.
Keywords. Digital, analog, and computer hologram, holography, 3D, optical.

Today, digital holography already has wide practical applications, and in the future, according to scientists, it will be indispensable in a number of fields, from medicine to astronomy. Physical principles of holography Holography is a method that allows recording information about an object and restoring its image, including three-dimensional form [1] . This is achieved by recording not only the amplitude of the light (as in a standard photo), but also the phase, which allows you to observe the image restored from the hologram at different angles. Holograms are recorded by recording the total amplitude of two light beams: the object (reflected from or transmitted through the object) and the reference. If they are coherent to each other - have a constant phase difference, then interference patterns are formed in the plane of application of the rays, recorded by digital photosensors or photosensitive media.

"The widespread development of digital holography began relatively recently, due to the advent of high-quality digital cameras, but a number of impressive results have been achieved. World trends With the help of digital holography, you can create real 3D visualization of objects and scenes. No special glasses are required to observe the scenes or to place the observer specifically. Based on this principle, 3D displays are currently being actively developed, which will allow you to imagine high-quality images. According to scientists, the time is coming when color images obtained from holograms will be similar to photographs in terms of color rendering quality and reproduce a three-dimensional image of an object [5] .

Using holographic principles to create an image of the interlocutor is one of the current achievements of 5G communication. According to experts, in a few years, this technology can be transferred to the format of commercial services. A very promising direction is 3D printing using holograms. The holographic image of the part is divided into sections by projection, and then each projection is quickly printed layer by layer under program control. The directions of digital holography used in scientific and practical research are actively developing: holographic microscopy (visualization of micro- and nano-objects) and holographic interferometry (dynamic recording of changes in object parameters - temperature, shape, refractive index). In addition, digital holography is already widely used in medical and biological visualization, coding, data transmission and storage systems, and also allows to increase the security of products, banknotes and bank cards. Russian achievements Today, a number of universities and companies whose laboratories have achieved significant results are engaged in research in the field of holography - both analog and digital. Thus, MEPhI National Research Nuclear University introduced a system for real-time dynamic recording, transmission and optical display of holograms with a resolution of at least 2 million pixels. This allows, for example, remote replay of scenes and objects recorded in the optical and infrared range, which can be used to record data in aggressive environments [4] .

eISSN: 2349-5715 pISSN: 2349-5707

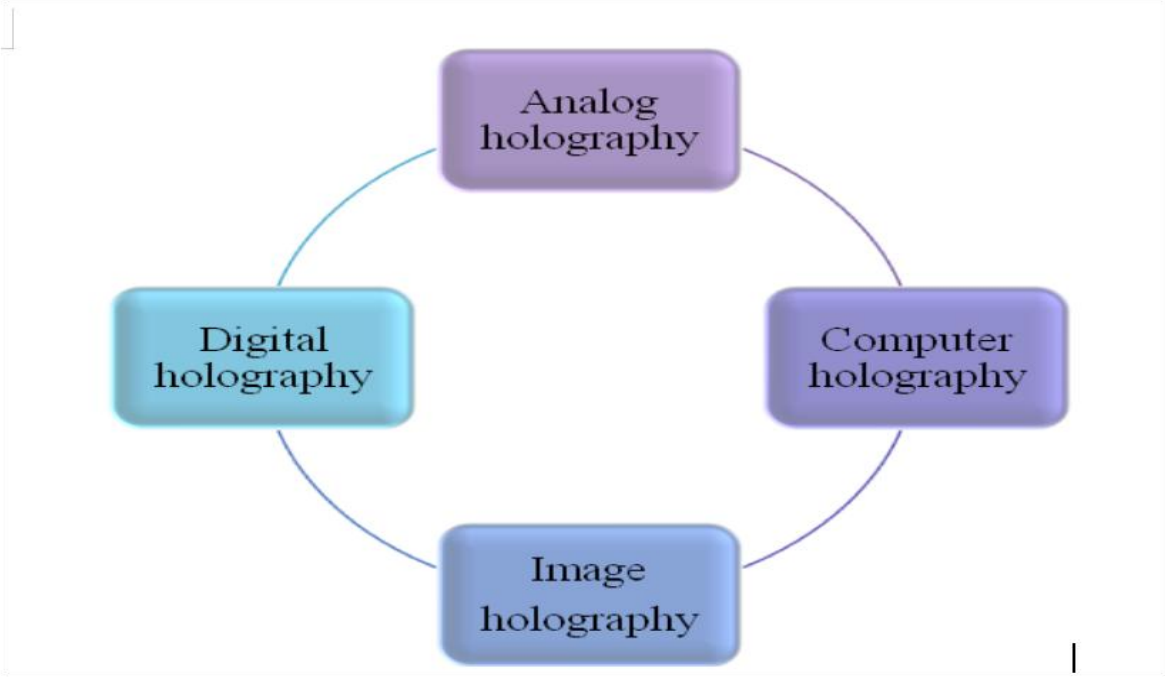
Volume: 11, Issue 06, June-2024 SJIF 2019: 4.702 2020: 4.737 2021: 5.071 2022: 4.919 2023: 6.980 2024: 7,662

Today, transmission of holographic video requires a channel with a capacity of at least one gigabit per second, so digital hologram conversion and compression technologies are of great importance. The National Research Nuclear University MEPhI is also actively working in this regard. In May 2019, the magazine "Scientific Reports" presented a method of compressing holographic data hundreds of times, developed as part of the implementation of the RSF grant #18-79-00277. Another important direction is to improve the quality of optical rendering of 3D scenes from recorded holograms. Institute of Laser and Plasma Technologies (LaPlaz) MEPhI National Research Nuclear University is developing ways to improve computer and realistic optical imaging of holograms using multilevel liquid crystal and binary high-speed micromirror light modulators. In 2019, scientists from the MEPhI National Research Nuclear University published a large-scale study on binarization methods to display 3D objects in the best quality in the journal OpticsandLasersinEngineering. As the scientists explained, this development could be useful in creating high-speed 3D displays. Holography is used not only to store, but also to protect information. NRNu MEPhI scientists are currently creating data encoding systems that use the image written on a hologram as an encoding key.

There are three main directions in a digital hologram:

1) recording,
2) increase
3) digital synthesis of holograms.

In the era of computerization, more and more physicists are turning to digital holography as a method of comprehensive study of the holographic process. Computing technology with wide capabilities of point-by-point image quantitative processing, simulating the entire hologram process from the first moment of hologram formation to the moment of restoration of the original image, including many intermediate stages of optical information conversion allows. The holographic method can be used for all waves: electron, X-ray, light, microwave, acoustic and seismic, when there are suitable coherent sources of these waves to form the corresponding holographic fields.



Currently, optical holography is the most common, which is primarily explained by the presence of lasers - sources of coherent radiation and means of recording and monitoring

eISSN: 2349-5715 pISSN: 2349-5707

Volume: 11, Issue 06, June-2024 SJIF 2019: 4.702 2020: 4.737 2021: 5.071 2022: 4.919 2023: 6.980 2024: 7,662

reconstructed images. Work on X-ray holography based on the use of wave devices - synchrotron sources of coherent X-ray radiation and digital reconstruction of holograms in the virtual space of a computer is actively being carried out, but these methods are not yet widely used. As for acoustic and seismic holography, they are currently almost not developed, because they cannot seriously compete with computer tomography methods widely used in introscopy in terms of information content [3] .

Analog holography is a holography based on the use of only physical elements in the holographic process, the object and reference waves.

Digital holography is holography based on digital registration and digital reconstruction of mathematical models of object and reference waves.

Computer holography is holography based on synthesis, diffraction structure model implementation and optical reconstruction.

Image holography - involves visual observation of holographic images of objects in a holographic process.

The procedure for obtaining a digital hologram, as a rule, includes the following steps:

1. Entering the holographic part of the image into the computer;
2. Calculation of amplitude and phase spectra of the image using algorithms of integral transformations (Fure, Fresnel);
3. To perform preparatory processes depending on the selected algorithm for outputting a digital hologram from a computer;
4. Production of hologram or photographic film for printing on an enlarged scale;
5. Reduction of the received hologram to the specified size by photographic method

Literature:

1. Qosimov A.S. To‘raev E. “Umumiy fizika” Termiz davlat universiteti nashriyoti. 2022 y.
2. Sh.Niyazov A.Orifxonov “Gologrаfiya va uning qo‘lanilishi” ilmiy-uslubiy qo‘llanma Guliston 2021y.
3. S.N. Koreshev «Osnovi golografii i golorammnoy Optiki» Uchebnoe posobie. Sankt-Peterburg 2016 g.
4. V.M.Ginzburg, B.M.Stepanov–«Gologrаficheskie izmereniya», M., «MIR», 1985g.
5. A.V. Perminov, I.S. Fayzraxmanova « Prikladnaya gologrаfiya» Kurs leksiy. Perm 2017 g.
6. Ostrovskiy Yu.I., Butusov M.M., Ostrovskaya G.V. Gologrаficheskaya interferometriya. - M.: Nauka. 2007.