

LASER APPLICATION : A REVIEW

Dr. Suman Lata^{a,*}, 

^a Associate Professor, Govt. Raza P.G. College Rampur, MJP Rohilkhand University Bareilly, (India)

KEYWORDS

Monochromatic, coherent, laser

ABSTRACT

Numerous areas of our lives already depend heavily on laser technology. No matter what sector you operate in, you probably use laser technology frequently for both professional and personal purposes. These are a few examples of how laser technology is used in daily life. Lasers produce well-controlled, coherent, monochromatic, and accurately directed light beams. Lasers are the best tools for focusing light in space, time, or at specific wavelengths. Measurement, cutting, drilling, welding, reading, writing, sending messages, solving crimes, removing plaque from arteries, and delicate eye surgeries have all been done using lasers on a regular basis. This paper discusses a few laser applications.

INTRODUCTION

In this research article I will discuss about the use of lasers has expanded recently. Coherent, monochromatic, finely focused light beams are produced by lasers. Measurement, cutting, drilling, welding, reading, writing, sending messages, solving crimes, eliminating plaque from arteries, and delicate eye operations are some important uses of Laser.

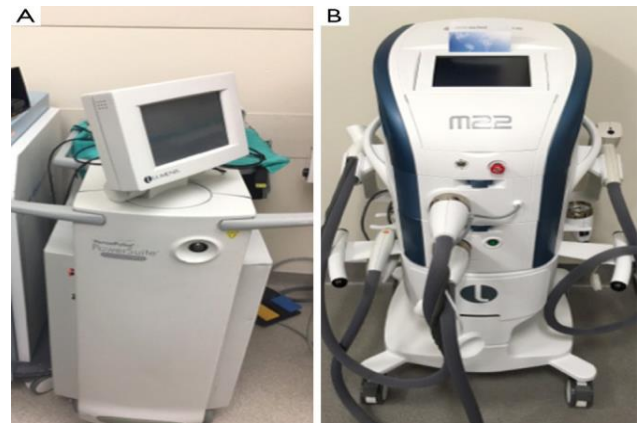
APPLICATIONS

• In Medicines

Medical teams were paying attention by its properties to concentrate the optical radiation energy into a minute region and opting eliminating and evaporating tissues. Because of these properties, it has become so essential in surgical treatment, its benefit being the option of execution a untouchable fine-contour tissue cut and deletion of minute structures without no harm to the nearby tissues and slightly probable septicity of the cut. Laser surgery make use of conversion of radiation into heat inside the soft tissue, executing the coagulation and incision at the same time. Laser Radiation has two important properties, Coherence & Monochromaticity, which are utilised mainly in medical diagnostic purpose. By advance research, now laser physics and invention of latest laser equipment, the laser is become more popular in latest branches of medicine like gynaecology, neurosurgery, ophthalmology, orthopaedic, urology, dermatology, oncology, and many more branches.



Source: https://en.wikipedia.org/wiki/File:Sharplan_40C.jpg



Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5220034/bin/atm-04-23-452-f2.jpg>

• LASER IN IMAGING AND HOLOGRAPHY

Coherence is one of the main property of laser radiation which stands necessary for holography and interferometry, which depend on light

* Corresponding author


E-mail: sumandashrath1979@gmail.com (Dr. Suman Lata).

DOI: <https://doi.org/10.53724/inspiration/v8n1.06>

Received 20th Nov. 2022; Accepted 20th Dec. 2022

Available online 30th Dec. 2022

2455-443X /©2022 The Journal. Published by Research Inspiration (Publisher: Welfare Universe). This work is licensed under a [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/)

 <https://orcid.org/0000-0001-8762-4876>

waves interactions, to make incredibly accurate dimensions and capture 3D images. The effect of combination of two light waves with one another relies on two waves in which they superimpose. When the peaks of two objects line up with one another's valleys, the two light waves interfere destructively; when the peaks of two light waves are line-up, the two waves interfere constructively to create an intense shiny spot. By the distribution of a beam into two alike portions that take separate pathways, this effect can be determined. A dark spot will appear if one of the paths is altered by just half wavelengths from the other. , Therefore this method is essential for accurate dimensions of very slight spaces. By dividing laser radiation into two alike shares and using one part of radiation to illuminate an object, holograms can be created. This object beam is then combined with the reference beam to form what seems to be a random pattern of bright and dark areas on a photographic plate, which records the object's wave front of light. When the reference beam and the laser light illuminate the pattern at the same angle, then it is scattered to produce an alike wavefront of light to the initial wave, giving the observer a 3D perspective of the item. Holograms may be created in bulk using the similar embossing technique as debit and smart cards and do not need laser light to be seen.

• LASERS USED IN INDUSTRIES

Many innovative processes are being used in industrial applications, including drilling, cutting welding (for example, crystal decorating, trimming, and milling), annealing, and sputtering. There is no mechanical touch is the fundamental advantage of using a laser beam to cut a product. Through using optical radiation, laser welding uses the least amount of surface vaporisation while melting the material to the appropriate depth. In contrast to some other procedures, a long laser pulse of order of ms and a low intensity optical beam is used for welding. The benefits of welding with laser are the lack of bodily contact to the electrode, for localised heating and cooling, and the ability to weld components in a harmless environment or enclosed into transparent optical materials. Lasers be able to join things like the impermeable safeguards of miniature relays, microelectronics contacts, pacemaker, and metallic part for vehicle.

In Laser drilling, material is removed by the process of vaporization. Laser drilling always use Pulse Laser (Pulse length > 1 nm).

Laser cutting is used to eliminate certain low thermal conductivity material. The aim of cutting is to vaporise the material as speedily as possible while minimising the thermally damaged region. Inert gas is brought to the site solely to remove the material that melted down or vaporised in order to cut non-metallic materials, such as wood, ceramics, and plastics, glass, paper, and textiles. The important benefit of laser cutting is its high speediness and versatility in cutting countless shapes.

- **In Research, Laser** is used in, Laser ablation, , Laser scattering, Laser Interferometry, Lidar, Micro dissection, Fluorescence, Microscopy, Metrology, Spectroscopy, Laser capture, Laser annealing

• Surveying

Semiconductor lasers and helium-neon lasers have progressed into essential parts of field surveyor equipment. This is because, because they provide an inch-perfect measurement to precisely reconstruct places, allowing the designs to be developed in perfect condition.

• Entertainment

Recently, laser displays have gained a lot of popularity, and special effects have become a significant part of live events like theatre productions and festivals. These lasers come under the 'Class 1' subcategory of laser classifications, which are thought to be secure in all circumstances of common use. A laser display may be absolutely amazing when combined with a fog machine and can do much more than just create the atmosphere for a music event.

Barcode scanners

It was a brilliant move to introduce lasers to the retail sector, and barcode scanners have made it more efficient than ever. The rationale is because they scan products and record the information on them, allowing them to track client behaviour and aid count stock levels—both of which are significant aspects of retail.

Laser Range Finding

Laser rangefinders are devices that can determine how far away an object is from the rangefinder. The time it takes for the laser to go to the target, reflect back, and then return to the rangefinder is used by these devices to calculate distance. Modern laser rangefinders can measure a distance to within a few millimetres of accuracy.

These tools are utilised in a number of areas, including as forestry, sports, 3-D modelling, and the military. Military-grade rangefinders can estimate an object's distance up to 25 kilometres away, providing incredibly precise measurements in the most dangerous conditions. Laser rangefinders and other items have been more widely accessible as a result of the advancements in laser technology, which are both more efficient and more cost-effective.

Laser Technology in Basic Science

The availability of narrow line width radiation enabled the revolution in laser spectroscopy. Atomic absorption spectrometers are effective for measuring weak spectral lines. There are numerous methods for finding weak spectral lines, including multiphoton ionisation spectroscopy and audio-visual spectroscopy. Additionally, there are nonlinear spectrum methods like photon absorption spectroscopy. The Raman spectrum recording process duration reduced from an hour to only minutes due to the laser. The argon-ion laser is the most often used laser for Raman spectroscopy. Lasers are employed in chemistry as a diagnostic instrument and as a way to trigger chemical processes. They also aid in the separation of an element's isotopes. Dye lasers, excimer lasers, carbon dioxide lasers, and other lasers are frequently utilised in chemical applications.

Weather

According to research, scientists may one day be able to use high powered lasers to trigger rain and lightning storms as well as micro-manipulate various other weather phenomena. Such a discovery might be able to end droughts, lessen weather-related disasters, and direct weather resources to places that need them.

LIDAR

"Laser imaging, detection, and ranging" or "light detection and ranging" are both abbreviated as "lidar." By using a laser to target an item or a surface and time how long it takes for the light to reflect back to the receiver, it is possible to calculate distances. When 3-D scanning and laser scanning are combined, it is sometimes referred to as 3-D laser scanning. LIDAR has uses on terrestrial, in the airborne, and on android platforms. With applications in surveying, geodesy, geomatics, archaeology, geography, geology, geomorphology, seismology, forestry, atmospheric physics laser navigation, aerial laser swath mapping (ALSM), and laser altimetry, high-resolution maps are frequently created using lidar. By altering the wavelength of light, it is used to create digital 3-D images of regions on the Earth's surface and the seabed that are in the intertidal and close to the coast. A growing number of autonomous vehicles and the helicopter Ingenuity have both used it for control and navigation during their record-setting flights over the terrain of Mars.

CONCLUSION

Although it's undeniably true that lasers are utilised in the future, sci-fi, and military contexts that we identify with the technology, many of us are ignorant of the important roles lasers play in our daily lives. Lasers were used in almost every field and aspect of life, and their use in modern civilization is only growing as the technology becomes more accessible and its advantages are more understood.

REFERENCES

1. Jelínek, M. – Kluiber, Z.: Tenké supravodivé vrstvy. VTM, 1991, 10, p. 41–43
2. Helena Jelínková, Zdeněk Kluiber, Laser Applications, page 201-212
3. Debabrata Goswami, Lasers and their Applications Page- 78-95
4. I. Gai, X., Choi, D.-Y., Madden, S., and Luther-Davis, B., Materials and Structures for Nonlinear Photonics, Chapter 1 in All-Optical Signal Processing—Data Communication and Storage Applications. Springer Series in Optical Sciences, Editors: Wabnitz, Stefan, Eggleton, Benjamin J. (Springer, New York, USA 2015)

5. Armstrong, S., All-Optical Storage. Nature Photonics 6, 636–637 (2012)
6. Sugioka, K. and Cheng, Y., Ultrafast lasers—reliable tools for advanced materials processing. Light: Science & Applications 3, e149, doi:10.1038 (2014)
7. Diddams, S.A., Jones, D.J., Ye, J., Cundiff, S.T., Hall, J.L., Ranka, J.K., Windeler, R.S., Holzwarth, R., Udem, Th., and Hänsch, T.W., Direct Link between Microwave and Optical Frequencies with a 300 THz Femtosecond Laser Comb. Phys. Rev. Lett. 84, 5102 (2000)
8. Hell, S.W., Nanoscopy with focused Light (Nobel Lecture). Angew. Chem. Int. Ed. 54, 8054-8066 (2015)
9. Betzig, E., Patterson, G.H., Sougrat, R., Lindwasser, O.W., Olenych, S., Bonifacino, J.S., Davidson, M.W., Schwartz, J.L., and Hess, H.F., Imaging Intracellular Fluorescent Proteins at Nanometer Resolution. Science 313, 1642 (2006)
10. Goldsmith, R.H., Moerner, W.E., Watching conformational- and photo-dynamics of single fluorescent proteins in solution. Nature Chemistry 2, 179–186 (2010)
11. Bloembergen, N., Nonlinear Optics and Spectroscopy. Nobel Lectures, Physics 1981-1990, Editor-in-Charge Tore Frängsmyr, Editor Gösta Eks-pong (World Scientific Publishing Co., Singapore, 1993)
12. Zewail, A. H., Femtochemistry: Ultrafast Dynamics of the Chemical Bond, Vols. 1 and 2 (World Scientific, Singapore 1994)
13. Goswami, D., Optical pulse shaping approaches to coherent control. Phys. Rep. 374(6), 385-481 (2003) Lasers and their Applications 95
14. Goswami, T., Das D.K., and Goswami, D., Controlling the femtosecond laser-driven transformation of dicyclopentadiene into cyclopentadiene. Chem. Phys. Lett. 558, 1-7 (2013)
15. Ashkin, A., Dziedzic, J.M., Bjorkholm, J.E., and Chu, S., Observation of a single-beam gradient force optical trap for dielectric particles. Opt. Lett. 11, 288-290 (1986)
16. Phillips, W.D., Laser cooling and Trapping Neutral Atoms. Rev. Mod. Phys. 70, 721-741 (1998)
17. De, A.K. and Goswami, D., Towards controlling molecular motions in fluorescence microscopy and optical trapping: a spatiotemporal approach. Int. Rev. Phys. Chem. 30(3), 275-299 (2011)
18. Mondal, D. and Goswami, D., Controlling local temperature in water using femtosecond optical tweezer. Biomed. Express 6, 3190-3196 (2015)
19. <https://www.scientificworldinfo.com/2019/10/importance-of-laser-technology-applications-of-lasers.html>
20. "California scientists able to control the weather using lasers - www.express.co.uk". 28 September 2017. Archived from the original on 2018-10-23. Retrieved 2018-10-23.
21. "The man who wants to control the weather with lasers - www.cnn.com". CNN. 24 April 2015. Archived from the original on 2018-10-23. Retrieved 2018-10-23
22. <https://www.andysowards.com/blog/2018/5-ways-laser-technology-used-everyday-life/>
23. <https://en.wikipedia.org/wiki/Lidar>
