IJTBI
International Journal of Technovation and Business Insights
Volume 02, Issue 02, April-June 2026
ISSN: 3107-7900, P.CODE: 26/2-2/37
DOI: https://doi.org/10.5281/zenodo.20718365

APPLICATIONS OF LASER IN AUTONOMOUS VECHILES AND OTHER FIELDS

[#1]**Dr. SK. MEERA SAHEB,** *Professor,*
[#2]**Y. VIJAYA,** *Assistant Professor,*
[#3]**P. SAILAJA,** *Assistant Professor,*
Sai Spurthi Institute of Technology(Autonomous), Sathupally, Khammam, Telangana

ABSTRACT: LIDAR is one of the many applications of lasers in recent times. The three main components of an LIDAR are explained first and the uses of drones in mapping and survey, wireless power transfer etc are also explained. Other uses of LIDAR in autonomous vehicles and agriculture are also elaborated. Key words: LIDAR, Drone, Autonomous vehicle

Keywords: *Laser Technology, LiDAR, Autonomous Vehicles, Self-Driving Cars, 3D Mapping, Object Detection, Distance Measurement, Navigation Systems.*

INTRODUCTION

LASER is the acronym for light amplification by stimulated emission of radiation. Laser is one of the priceless invention of the 20th century, Einstein gave the theoretical basis for the working of laser in 1916 through stimulated emission, The Maiman built the first laser device 1960.Ali javan developed the He-Ne gas laser, the first gas laser Pater has constructed The CO2 lasers is indispensable in various industries. Argon ion laser is one of the ion laser which is capable of producing many wavelengths ranging from 3510_5200A^{o}, semiconductor laser is Designed for reading and writing data in computers.

Lasersare capable of delivering coherent, monochromatic, well-controlled, and precisely directed light beams. A priori, therefore, lasers would seem Tobe poor choices for general-purpose illumination, however, they are ideal for concentrating light in space, time, or particular wavelengths. Lasers have been regularly used to measure, cut, drill, weld, read, write, send messages, solve crimes, burn plaque out of arteries, and perform delicate eye operations. Over and over again the laser has proved to be an extremely practical tool. Nevertheless, lasers have also proved their usefulness in non-practical applications, especially in the realm of art and entertainment. Lasers are involved in almost all aspects of these fields, from “light shows” to Compact Discs (CDs) and Digital Video Discs (DVDs), to special effects in the movies. Some other commonplace applications of lasers are as Laser pointers, barcode scanners, laser printers, etc. Still, much of the important modern day celebrated applications lie in the fiber-optic communication, laser machining and fabrication, trace element detection, laser metrology and medical imaging.r: Laser havethe following highly lightly interesting characteristics.

Directionality:

normall emit light in one direction which is parallel to the axis of the resonant cavity (A pair of mirrors) while conventional the conversation light is exited in all directions.

Volume 02, Issue 02, April-June 2026
ISSN: 3107-7900, P.CODE: 26/2-2/37
DOI: https://doi.org/10.5281/zenodo.20718365

This features are useful in metrology. (Astronomical distance measurement)

Mono chromaticity: Laser light is highly monochromatic i.e. single colored light with single wavelength. The wavelength spread is less than $10A^0$. Ordinary light source has spread of wavelength in the range of $100A^o$ to $1000A^o$.

Coherence: In laser a large no of identical photons is generated through stimulated emission and they have phase correlation with through each other. such light is called coherent light. the phase correlation is not maintained among the photons in ordinary light.

Intensity: Light in a laser propagates as plane waves. the laser beam contains a beam of parallel rays. For instance the divergence of helium neon (He-Ne laser) is 10^{-3} radiation. Light from a conventional source spreads in all directions in the form a spherical wave front so it is divergent.The above features of Lasers are useful in autonomous vehicles.

Autonomous vehicles:

Autonomous vehicles are vehicles capable of sensing their environment and navigating safely without human input. Artificial intelligence, sensors, cameras and radar are important components in AVs. LiDAR are commonly installed on top of vehicles in automotive applications.

Laser pulses are emitted continuously in 360° surroundings of the vehicle. Distance measurement is possible by receiving the reflected laser beam from the nearby object. 3D mapping is produced by measuring distances to numerous points. Objects are recognized by using machine learning algorithms. Objects are classified as other vehicles, pedestrians and road signs.

There are two types of LiDARs – Electromechanical LiDAR and Solid-state LiDAR. The first type has multiple moving parts so they are bulky and expensive. All components in a solid-state LiDAR are integrated on a single chip, so they are compact, lightweight and low cost. These are operated in the wavelength range 905–1550 nm (IR and invisible to naked eye). CO_2 lasers are used when high power is required.

Laser Imaging and Holography

The coherence of laser light is crucial for interferometry and holography, which depend on interactions between light waves to make extremely precise measurements and to record three-dimensional images. The result of adding light waves together depends on their relative phases. If the peaks of one align with the valleys of the other, they will interfere destructively to cancel each other out; if their peaks align, they will interfere constructively to produce a bright spot. This effect can be used for measurement by splitting a beam into two identical halves that follow different paths. Changing one path just half a wavelength from the other will shift the two out of phase, producing a dark spot. This technique has proved invaluable for precise measurements of very small distances. Holograms are made by splitting a laser beam into two identical halves, using one beam to illuminate an object. This object beam then is combined with the other half— the reference beam—in the plane of a photographic plate, producing a random-looking pattern of light and dark zones that record the wave front of light from the object (Fig. 4). Later, when laser light illuminates that pattern from the same angle as the reference beam, it is scattered to

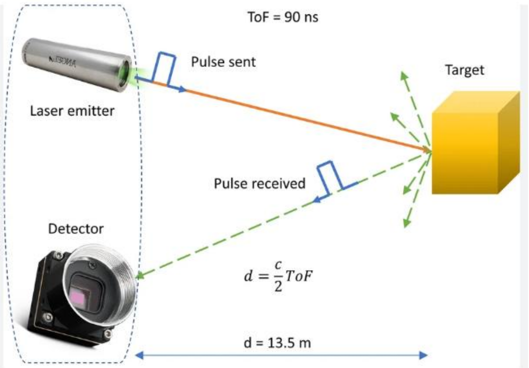
International Journal of Technovation and Business Insights
Volume 02, Issue 02, April-June 2026
ISSN: 3107-7900, P.CODE: 26/2-2/37
DOI: https://doi.org/10.5281/zenodo.20718365

reconstruct an identical wave front of light, which appears to the viewer as a three-dimensional image of the object. Holograms now can be mass-produced by an embossing process, as used on credit cards, and do not have to be viewed in laser light.

Figure 4: Schematic of Holography process where the laser beam is split into three components. First two beams are needed to create the hologram which is viewed with the help of the third.

Weed control by lasers: there are two components. The first one is the AI scanner which identify the weed among the crop saplings. The second component is the controlled laser beam Which is capable of focusing on the weed. The weed is fired to death by using powerful laser beam. The rate of destruction is 100000 weed per hour by blue laser light.

LiDAR: Light detection and ranging is the expansion for LIDAR has wide range of applications. Autonomous vehicles, robotics drone navigation. Environmental monitoring. Forest management and many more. The frequency of laser light is modified after reflecting from the target



APPLICATIONS

Aerial Inspection: Drones use LiDAR for inspecting hard-to-reach locations like power lines and civil infrastructure.

Precision Agriculture: Agriculture companies can optimize water, fertilizer and pesticide usage.

Conclusions: laser is a new form of electromagnetic radiation and it has novel structure characteristics. These characteristics give rise to interesting applications in various fields. Argon-ion laser has medical and entertainment uses. There is vast potential of designing new lasers for drones and agriculture that have precious applications.

REFERENCES

1. 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 Se-ries in Optical Sciences, Editors: Wabnitz, Stefan, Eggleton, Benjamin J. (Springer, New York, USA 2015)
2. Armstrong, S., All-Optical Storage. Nature Photonics 6, 636–637 (2012)
3. Sugioka, K. and Cheng, Y., Ultrafast lasers—reliable tools for advanced materials processing. Light: Science & Applications 3, e149, doi:10.1038 (2014)
4. 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 Femtose-cond Laser Comb. Phys. Rev. Lett. 84, 5102 (2000)
5. Hell, S.W., Nanoscopy with focused Light (Nobel Lecture). Angew. Chem. Int. Ed. 54, 8054-8066 (2015)
6. Betzig, E., Patterson, G.H., Sougrat, R., Lindwasser, O.W., Olenych, S.,

Volume 02, Issue 02, April-June 2026
ISSN: 3107-7900, P.CODE: 26/2-2/37
DOI: https://doi.org/10.5281/zenodo.20718365

Bonifacino, J.S., Davidson, M.W., Schwartz, J.L., and Hess, H.F., Imaging Intracellular Fluorescent Proteins at Nanometer Resolution. Science 313, 1642 (2006)

7. Goldsmith, R.H., Moerner, W.E., Watching conformational- and photodynamics of single fluorescent proteins in solution. Nature Chemistry 2, 179–186 (2010)
8. Bloembergen, N., Nonlinear Optics and Spectroscopy. Nobel Lectures, Physics 1981-1990, Editor-in-Charge Tore Frängsmyr, Editor Gösta Ekspong(World Scientific Publishing Co., Singapore, 1993)
9. Zewail, A. H., Femtochemistry: Ultrafast Dynamics of the Chemical Bond, Vols. 1 and 2 (World Scientific, Singapore 1994)
10. Goswami, D., Optical pulse shaping approaches to coherent control. Phys. Rep. 374(6), 385-481 (2003)
11. 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)
12. 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)
13. Phillips, W.D., Laser cooling and Trapping Neutral Atoms. Rev. Mod. Phys. 70, 721-741 (1998)
14. 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)
15. Mondal, D. and Goswami, D.,Controlling local temperature in water using femtosecond optical tweezer. Biomed. Express 6, 3190-3196 (2015)