Contemporary Engineering Sciences, Vol. 10, 2017, no. 10, 457 - 461
HIKARI Ltd, www.m-hikari.com
https://doi.org/10.12988/ces.2017.7437

Study of Evolution for 3 – D Vision of Pulsed Laser System Design to Repellent a Rodents

Mohammed H. Hwidi

Dijlah University College
Department of Computer Techniques Engineering, Iraq

Abstract

The most troublesome problem for farmers is the rodents that kill or destroy their crops. It suggests creating an idea to eliminate rodents or to reduce the impact of rodents on crops.
The low – energy pulse laser will be used to drive out rodents by scanning the field. The 3D scan is used with the use of a specific optical correlation method and rotation, increasing the likelihood of rodents being detected and expelled outside the farm to keep crops from damage.

Keywords: laser, repellent, rodent

1. The Ultrasound Laser

There are several cases in a non – destructive ultrasound test where the contact between a transducer and a model is either unacceptable or not applicable, This technique is successful and effective for the diagnosis of composite materials in the field of aviation and monitoring the coordinates of mobile targets for the purpose of dealing with them, for example; when the target to be tested moves alone or moves with the wave, the optical method will be more desirable in this case. [6, 8]

Ultrasound is generated by pulse of laser beam on a material that absorbs part of it. The optical power absorbed by the material will be converting to heat leading to local increase in temperature, which leads to rapid localized thermal expansion leading to generate ultrasound into the medium. [6, 8]

Rodents hearing ranges between (200 Hz – 90 KHz), high range is enough to repel the rodents and force them to leave the place, the range of this frequency is limit by (20 – 40 KHz).
The downside of region is that it could be hear by another animal. To deal well with this problem, using the range finder technology alone with the use of the link (correlation) technique to locate the desired animal and find it and then immediately launch the ultrasound beam towards the target. [9]

2. Laser Range Finder Technique

This type of measurements depends mainly on the type of signal whether ultrasonic or optical signal, which will be objected into a moving target. The reflected or scattered signal is then processed to determine the target distance. The ways of optical distance measurements can fall in three main categories: time – of – flight, triangulation methods, and interferometer. [5]

2.1 Laser Pulse Time – of – Flight (TOF) Distance Measurement

The time measurements starts when a pulse laser emits a short light pulse, time is stopped when the pulse laser is reflected from the target and reaches the light detector. The distance of the target can be computed by elapsed time between start and stop the pulse.
Distance measurement depends on several parameters: [7]

- Laser peak power
- Beam divergence.
- Optics.
- Characteristics of media.
- Reflectivity of the target.
- Sensitivity of detector.

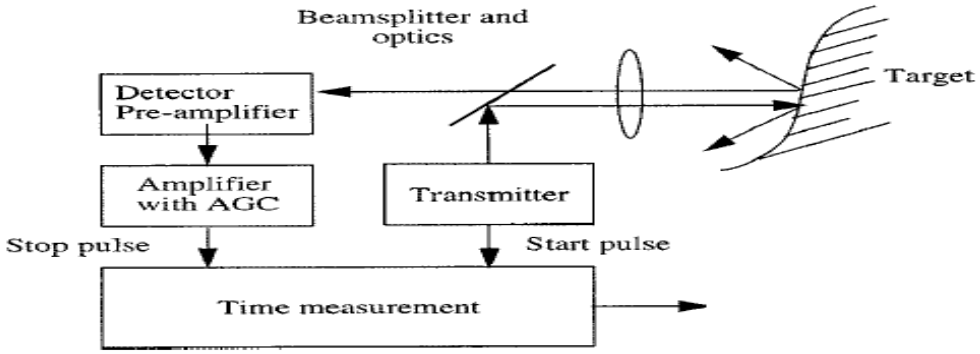

Fig. (1) Block diagram of TOF laser range finder

2.2 3D – Vision of Pulsed TOF Laser Range Finders

When using 3 – D vision technology, it gives several characteristics relative to the use of other optical methods. The dimensions and measurement are accurate and there are no ambiguities random projections, whether horizontal or vertical, because the beam used in the measurement is narrow and there are no problems that the target is hide beyond another body in the horizon, as in the triangulation. [4]
The TOF method is most often faster than the rest of the methods used to analyze the image created using the camera. The sensors that make the 3D images can be classified by distance to short – range sensors (<10m) and long – range sensors that exceed 10m. [1]
One of the best and most accurate short – range sensors TOF (3D) is a 10 KHz sensor that uses a pulse laser and a light multiplier tube. This device can display a 64 x 64 pixel image within 4 seconds with a high resolution of up to 2.5 mm, and a range of 4 m maximum. [3]

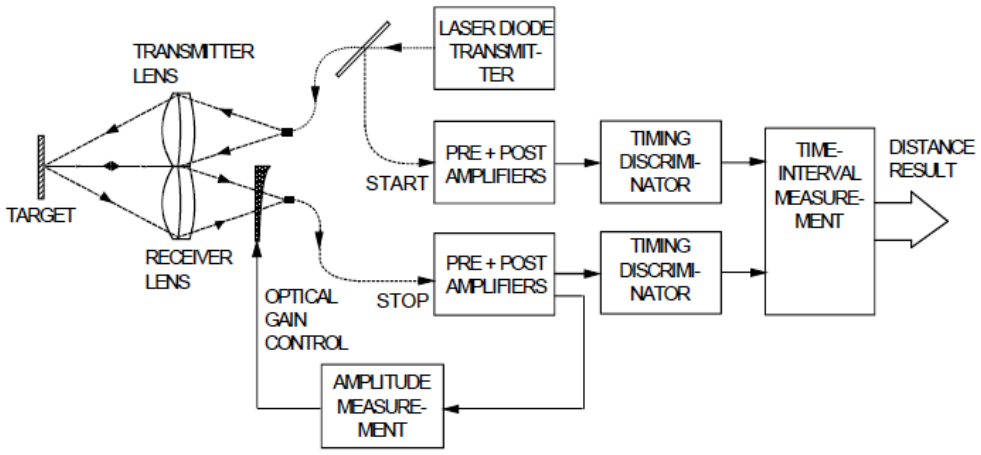

Fig. (2) The structure of a two – channel TOF laser range finder

Correlation Techniques:

Optical correlation (bonding) technology is an important technique, and is applied by using a double Fourier Transform (FT). Fourier transforms can be achieved instantaneously (with a simple lens that leads to convergence of rays).
In order for the performance of optical correlation techniques to be good and effective, there are supposed to be two basic approaches to correlate and to ensure their effectiveness: Vander Lunt correlated, and JTC (Joint Transform Correlated). Both approaches are adopted:

- On an optical set, called a "4F" set up (generally an optical system consisting of two adjacent lenses).
- On the differences between the target image and the reflected image coming from the data – base.
- On a primitive detection of peak correlation. The latter measures the degree of congruence between the target image and the reflected image.

In general our extensive research and periodic changes in inputs are useful because the target is in motion. Scanning all angles detectable through the target, and include it in the database of what requires that the system designed to reduce the coherence of detection signal in addition to it will reduce the error rate of the probability of correct. [2]

Conclusions

From this project, the following points were concluded:

- Pulsed laser can generate 20 kHz to 40 kHz which is very suitable for driving rodents off farms.
- The use of detection methods depends on the concepts of size and rotational correlation method to detect all possible angles of the desired target.
- The disadvantages of this research will be in the field of frequencies used, because most animals have the ability to hear at the same frequency, and this will cause to be expelled most of them.
- Scope Finder technology is used as the scanning method to determine the distance from the target to the device, so it will be appropriate to determine the target type and determine the appropriate frequency to expel the target explorer.
- The above idea may be applied to any type of animal that may cause damage to the farm and crops, thereby eliminating loss and ensuring the safety and quantity of crops from damage and vandalism.
- In addition to this, this design can provide a simple report to detect the harmful targets and determine the time of release frequency as it is in the report so that the farmer can read the report and assess the conditions surrounding his land.

References

[1] D.C. Carmer, L.M. Peterson, Laser Radar in Robotics, *Proceedings of the IEEE*, **84** (1996), no. 2, 299 – 320. https://doi.org/10.1109/5.482232

[2] David Casasent and Demetri Psaltis, "Position, rotation, and scale invariant optical correlation, *Applied Optics*, **15** (1986), no. 7, 1795-1799. https://doi.org/10.1364/ao.15.001795

[3] R. A. Jarvis, A Laser time – of – Flight Range Scanner for Robotic Vision. IEEE Transactions on Pattern Analysis and Machining Intelligence, **PAMI-5** (1983), no. 5, 505 – 512. https://doi.org/10.1109/tpami.1983.4767429

[4] R.A. Lewis, A.R. Johnston, A scanning laser rangefinder for a robotic vehicle, *5th International Conference on Artificial Intelligence*, **2** (1977), 762 – 768.

[5] Markus-Christian Amann, Thierry Bosch, Marc Lescure, Risto Myllyla, Marc Rioux, Laser ranging: a critical review of usual techniques for distance measurement, *Optical Engineering*, **40** (2001), no. 1, 10-19. https://doi.org/10.1117/1.1330700

[6] J.-P. Monchalin, Optical detection of ultrasound, *IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control*, **33** (1986), no. 5, 485-499. https://doi.org/10.1109/t-uffc.1986.26860

[7] P. Palojärvi, *Integrated Electronic and Optoelectronic Circuits and Devices for Pulsed Time-of-Flight Laser Range Finding*, Oulu University Press, University of Oulu, Finland, 2003.

[8] C.B. Scruby and L.E. Drain, *Laser Ultrasonic: Techniques and Applications*, Hilger, Bristol, 1990.

[9] Sridhar Krishnaswamy, Theory and Applications of Laser-Ultrasonic Techniques, Chapter in *Ultrasonic Nondestructive Evaluation*, 2003. https://doi.org/10.1201/9780203501962.ch7

Received: April 25, 2017; Published: May 23, 2017