# COETZER OPTICAL SYSTEMS (Pty) Ltd

# Off-axis diode lidar

## Overview

Protecting Detector in a Lidar System Using Off-Axis IlluminationTechniques for off-axis illumination, which can be implemented in a lidar system similar t.

## Key Takeaways

Off-axis diode LiDAR uses laser diodes to emit pulses while detecting returned light at an oblique angle to protect the detector and optimize performance.Overview

Off-axis diode LiDAR is a type of light detection and ranging system that employs laser diodes as the light source and positions the receiver at an oblique or off-axis angle relative to the emitted beam. This configuration allows the system to measure distances to remote targets while reducing the intensity of light directly hitting the detector, which is particularly important for nearby or highly reflective objects .

How It Works
• Laser Diode Emission: Pulse laser diodes generate short, high-power optical pulses. These pulses are typically in the nanosecond range and can reach wavelengths such as 905 nm, commonly used in automotive and mapping applications . The pulse width and duty cycle are carefully controlled to prevent damage to the diode and to achieve high optical output power.

• Scanning Mechanism: The emitted pulses are directed across a field of regard using a scanner, such as a rotating polygon mirror or galvanometer, to cover the desired area . Each pulse travels to a target, reflects, and returns to the receiver.

• Off-Axis Detection: The returning light is directed onto the detector at an oblique angle rather than head-on. This reduces the risk of saturating or damaging the detector from strong reflections, especially from nearby targets, while still allowing accurate time-of-flight measurements . The operational angle can vary depending on the distance of the target, increasing with distance to optimize detection.

• Detection and Signal Processing: Detectors, such as photodiodes, avalanche photodiodes (APDs), or single-photon avalanche diodes (SPADs), capture the scattered light. Off-axis illumination helps maintain high sensitivity while protecting the detector from excessive optical power . The system then calculates the distance based on the time-of-flight of the pulses.

Advantages

• Detector Protection: Off-axis illumination prevents high-intensity reflections from saturating or damaging the detector, extending its lifespan .

• Improved Dynamic Range: By controlling the angle of incidence, the system can handle both near and far targets without compromising measurement accuracy.

• Enhanced Safety: Reduces the risk of eye exposure to high-intensity laser light in automotive or industrial applications.

• Compatibility with Diode Arrays: Multiple laser diodes can be used in a matrix to increase coverage while maintaining safe detection levels .

Applications

• Autonomous Vehicles: For obstacle detection and navigation, where nearby reflective surfaces could otherwise overwhelm the detector.

• Robotics and AGVs: Indoor and constrained environments benefit from off-axis detection to handle close-range reflections.

• Mapping and Surveying: Drones and aircraft use off-axis LiDAR to improve measurement accuracy over varying terrain and distances.

Key Considerations

• Laser Diode Drive: Pulse width, duty cycle, and current must be carefully managed to achieve high optical output without damaging the diode .

• Detector Selection: High-sensitivity detectors like SPADs or APDs are preferred for off-axis systems to maintain signal quality while minimizing noise .

• Optical Alignment: Precise alignment of the laser and detector is critical to ensure accurate ranging and to maximize the benefits of off-axis illumination. In summary, off-axis diode LiDAR combines the efficiency of laser diodes with strategic detector positioning to achieve high-performance ranging while protecting sensitive components, making it ideal for automotive, robotic, and mapping applications .

## Article Content

A Compact MEMS-Based Optical Scanning System with Large

In this work, a design of a compact optical MEMS-based lidar scanning sys-tem with a large field of view (FOV) and small distortion

Detailed study of laser diode array collimation based on a

The performance criteria are derived from the overall LiDAR system requirements and applied to an optical system consisting of a

Off-Axis Four-Reflection Optical Structure for ...

For these reasons, this paper presents an off-axis four-reflection optical structure for single-band (532 nm) bathymetric

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