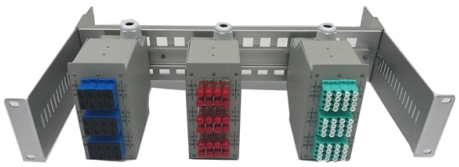
Optical Module Light Guide Adjustment Method



Overview

With the intention of achieving this goal, we introduce a novel automatic adjustment system designed for LED modules.

Key Takeaways

Light guide adjustment in optical modules involves precise alignment of the light-emitting element and optical waveguide to optimize coupling efficiency and minimize positional deviation.

Core Principles

Optical modules typically consist of a light-emitting element and an optical waveguide, which can be an optical fiber or a silicon waveguide. Light propagates through the waveguide in fundamental and first-order modes, creating a light intensity distribution that must be carefully aligned at the output end to maximize coupling efficiency. Proper adjustment ensures that high-intensity portions of the light are centered and evenly distributed, reducing sensitivity to optical axis deviations.

Adjustment Techniques

Positional Alignment

The optical waveguide is positioned relative to the light source so that the intermediate light intensity distribution aligns with the target output plane. This can be achieved using micro-actuated precision grippers with integrated tilt functions, allowing micrometer-level adjustments in X, Y, and Z directions.

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Angular Alignment

Angle errors in the light coupling plane are critical. High-precision assembly systems use tilt-capable grippers to rotate the module around a center of rotation on the component, correcting angular misalignment without backlash. Symmetrical solid-state joints can enable circular movement over small angular ranges (±2°), ensuring precise orientation of the light guide relative to the waveguide.

Simulation and Design Optimization

Software tools like VirtualLab Fusion allow simulation of light propagation through the guide, including polarization, diffraction, and grating effects. Designers can configure grating regions and surface layouts to optimize light distribution and coupling efficiency before physical assembly.

Iterative Testing

After initial alignment, the module is tested for light intensity uniformity and coupling efficiency. Adjustments are iteratively refined using feedback from optical measurements, ensuring optimal performance.

Practical Considerations

Mode Management: Ensure the waveguide supports the desired modes at the operating wavelength to maintain consistent light distribution. Mechanical Stability: Use precision fixtures to prevent drift during adjustment. Cost Efficiency: By allowing some tolerance in positional deviation while maintaining high coupling efficiency, manufacturing costs can be reduced.

Automation Potential: High-precision grippers and simulation-guided alignment enable transition from manual laboratory adjustments to automated industrial assembly.

Summary

The optical module light guide adjustment method combines positional and angular alignment, simulation-based design, and iterative testing to achieve optimal light propagation and coupling efficiency. Using micro-actuated grippers with tilt functions and software-assisted design ensures precise, reproducible, and cost-effective assembly of optical modules for applications in projection systems, optical communication, and illumination technologies.

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Article Content

Machine Vision System for Automatic Adjustment of Optical ...

With the intention of achieving this goal, we introduce a novel automatic adjustment system designed for LED modules. This system possesses versatility and can be tailored to various

Designing Light Guides for Illumination Systems

What is a light guide? Luminance calculations are extremely time-consuming (hours, days, ...) and thus can be used only for final design verification. Optimization requires fast calculations based on

(PDF) Machine Vision System for Automatic Adjustment of Optical ...

Abstract and Figures This paper presents a machine vision system that performs the automatic positioning of optical components in LED modules of automotive headlamps.

Machine Vision System for Automatic Adjustment of Optical

The purpose of this work is to present a machine vision system for the automatic adjustment of LED modules for automotive lighting. One of the advantages is the flexibility to adapt to new models.

Creating a lightguide

A light guide is a pipe guiding the light while extracting a ratio of this light in a specific direction using prisms. Line-shaped lit appearance is achieved by this element.

The basics of optical alignment

This guide details essential alignment steps, from beam path setup to lens collimation and centering, introduces key tools like pinholes and shearing interferometers, and advocates for a

Exterior Lightguide Optimization

In this example, we will use Speos and optiSLang to optimize a prismatic lightguide to fulfill the automotive Day-Time-Running-Lights regulation and improve the

TI DLP® System Design: Optical Module Specifications

Brightness of an optical module varies as the white point (such as the relative mix of red, green, and blue light that creates white light) is adjusted. For the most accurate measure of performance,

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34. Designing and Optimizing Light Guides

Learn techniques for optimizing light guides in OSLO. This guide covers key methods to enhance light guide performance for various optical applications.

(PDF) Light guide design principles

Abstract A general theory of optical transport systems has been developed that can be used to determine preliminary design specifications for light guide systems.

Light Guide | Principles, Applications & Design

Explore the principles, applications, and design of light guides in geometrical optics, from fiber optics to AR technology and medical devices.

ax6627_cover

4-1 Adjusting the Light Guide Angle (Interlock Light Guide Only) } Angle adjustment is not necessary for the flexible light guide provided that it is attached to the normal position.

How to Customize Your Light Guide Solution for Optimal Performance

Enhancing Light Guide Solutions to Meet Complex Project Requirements At first glance, light guides seem fairly basic. They''re made from optically clear polymers such as acrylic (PMMA) or

Optimization of Lightguide with Continuously Modulated Grating Regions

Application of the Footprint and Grating Analysis tool including the generation of the optical setup equipped with all requirements for the parameter modulation Definition of desired modulation of

PowerPoint Presentation

Optimization of Coupling Gratings for Lightguide-Based Displays Speaker: Huiying Zhong1 Roberto Knoth1, Stefan Steiner1, Site Zhang1, Yichen Liu2, Christian Hellmann3, and Frank Wyrowski2

Design and optimization of a flexible fiber-conducted laser light guide ...

The system adopts the fiber optic transmission method of electro-optical separation, which has certain application prospects in the fields of underwater detection, decorative lighting and urban

(PDF) Machine Vision System for Automatic Adjustment

In all cases, the automatically adjusted LED modules followed the ECE R112 regulation for automotive lighting. Machine vision system for the

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Fundamentals of Optical Waveguides

The beam propagation method is the most powerful technique for investigat-ing linear and nonlinear lightwave propagation phenomena in axially varying waveguides such as curvilinear directional

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This document is for preliminary research. Verify specifications against current standards, product documentation and project requirements.

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