Introduction

Vertical cavity surface emitting lasers (VCSELS) have been invented for years but their complex interactions between electrical and optical fields are still active research areas. Using a Raspberry Pi and a camera, we aim to achieve high performance in the measurement of VCSELS’ electrical and optical features.

Objective

- Overcome the problem about the software incompatibility between the electrical and optical system. Make the whole system more automatic and synchronous.
- Build an optical system for the measurement of all kinds of VCSELS, including bare and packaged VCSELS.

Method

- Use a Raspberry Pi (a microcomputer) to separate the image capturing process from a traditional computer.
- Use Zemax to analyze and design a common optical system include microscope objective and lens.

System Overview

- The computer control the derivative machine
- Send a signal to trigger the capture
- Send images to the monitor
- Adjust the camera
- GUI of Camera Drive Software
- Monitor
- Raspberry Pi
- Objective
- VCSEL
- Lens
- Camera
- Optical System
- Raspberry Pi 2B
- Microscope Objectives
- VCSEL Spot
- Derivative Machine

Test result

- The laser threshold current can be easily located, which is represented by the rapid rising in the derivative curves. Beneath the threshold the total absorption exceeds total emission, causing zero light output.
- Optical modes can be observed in captured images. Only certain area of the exit pupil (the filament) outputs light at a certain current or voltage. This indicate nonuniformity of current inside the VCSEL.

Summary

- The newly designed test system shows both higher speed and precision, and exhibits more automation, making the data processing more effective.
- In order to reduce nonuniformity of current, the physical patterns inside a VCSEL still needs more analysis.

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