Visible Light Communication Via GaN LEDs

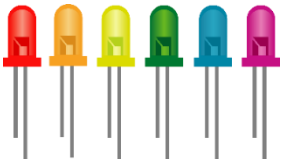
SSLEEC

Solid State Lighting and Energy Electronics Center (SSLEEC)

Dr. Steven P. DenBaars
Mitsubishi Distinguished Professor

Roark Chao
SPIE Optics + Photonics Scholar





Project Description

The explosive growth of large language models and cloud-based services has created an urgent need for high-throughput, low-latency interconnects in modern data centers. Visible-light communication (VLC) has emerged as a promising solution, offering orders-of-magnitude higher bandwidth than conventional telecom links. However, widespread adoption is limited by the lack of cost-effective, high-speed devices capable of both transmitting and detecting optical signals.

Gallium Nitride (GaN) light-emitting diodes (LEDs) present a compelling pathway forward. With their high modulation rates, compact footprint, and enhanced safety compared to traditional lasers, GaN LEDs are not only advancing next-generation display technologies but are also strong candidates for optical data communication as VLC devices.
The goal of this project is to design and implement a free-space optical system to evaluate the performance of LEDs in a VLC environment.

Student teams will:

- Fabricate their own LEDs using semiconductor processing techniques,
- Build a free-space optical setup to test emission and detection, and
- Characterize device performance as both emitters and transceivers in realistic VLC scenarios.

This hands-on project integrates device fabrication, optical system design, and communication system testing—providing students with experience at the intersection of materials science, optoelectronics, and data communication

1 **Optical System**	An optical system is needed, where the transmitted LED signals are lensed into a photodetector and processed to reconstruct the initial input signals sent to the LEDs.	Optical ray tracing Intensity modulation Signal processing
2 **Driver PCB**	A driver PCB to individually address each LED on a wafer is necessary to efficiently communicate data. This PCB should be reconfigurable to individually address LEDs and their micron-scale equivalents.	PCB design/layout Embedded systems Electronic/Photonic circuits
3 **System Aligner**	Oftentimes, it is difficult to align optical components. This calls for a quick auto-alignment system that integrates into the physical optical system to quickly align the LEDs and receiver photodetector(s).	Automation Feedback algorithms Computer vision