

**On-Off-Key Optical CubeSat Communications Payload using Commercial-off-the-Shelf (COTS) Components. Advisor: Eduardo Rojas.**

NASA considers optical communications as the emerging technology of choice to enable high-data-rate deep space wireless communications. Laser communication systems can achieve data rates in the hundreds of gigabits per second with payload size, weight, and power typically lower than traditional microwave systems.

This senior design project will focus on the design, fabrication, and demonstration of a low-cost On-Off-Key (OOK) optical communications system tailored for CubeSat payloads. The system will leverage commercial-off-the-shelf (COTS) components alongside a limited number of custom PCBs to balance cost, manufacturability, and performance.

The project addresses both software and hardware challenges:

Software Development: Program onboard computers for sensor data acquisition, signal modulation (OOK encoding), and transmission; implement data handling for both real-time display and onboard storage.

Hardware Development: Design and fabricate a laser-diode-based transmitter, integrate an optical sensor as the receiver, and implement a two-axis pointing mechanism for beam steering and alignment.

High-Level System Requirements:

The system shall include a sensor payload (e.g., an optical camera) to generate data for transmission.

The system shall encode and transmit this data using OOK modulation, controlled by the onboard computer and a laser diode driver.

The laser beam shall be steered by a two-axis pointing mechanism to locate and maintain alignment with the receiver.

The system shall include an optical receiver with a sensor connected to the onboard computer for data decoding.

The system shall support real-time display of received data (e.g., video feed) and simultaneous onboard storage.

The system shall operate on battery power to enable standalone functionality.

Through this project, students will gain hands-on experience in optical communication system design, spanning embedded software, optoelectronics, pointing mechanisms, and full payload integration. The result will be a demonstrated low-cost CubeSat-compatible OOK optical link that advances the feasibility of COTS-based deep space communication systems.