

# Constellation Optical Link

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A constellation optical link enables high-bandwidth, low-latency communication between multiple small satellites in low Earth orbit. This project develops and evaluates an optical inter-satellite link model using Gaussian beam propagation while accounting for diffraction, thermal effects, alignment jitter, pointing accuracy, and free-space attenuation. Analytical models are validated through MATLAB simulations to assess link margin, beam divergence, and received-power performance across 50–500 km LEO separations.

The optical terminal architecture includes laser drivers, seed-laser and amplifier stages, and a transmitter/receiver system incorporating beam-expansion optics and closed-loop pointing, acquisition, and tracking (PAT). Receiver performance is modeled using photodiode detection with optical filtering and aperture-size sensitivity analyses.

This work proposes a modular, power-efficient optical communication terminal suitable for scalable multi-satellite constellations, with the goal of improving inter-satellite communication reliability and supporting future CubeSat-class optical-communication missions.