Advancing Secure Small Satellite Laser Communications

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Given the growing demand for high-speed communication with small-satellites from space, a low-cost, orbital laser communication network could meet these needs without being hampered by RF congestions and licensing challenges. A nanosatellite based global laser communications network capable of Gbit/s speeds is currently in development but lacks a suitable receiver for laser outputs beamed at the satellite clusters. This proposed project envisions 100 clusters of 4 3U CubeSats, totaling 400 satellites in need of a link. The overarching system requires accurate and repeatable laser transmissions to communicate between the next cluster, the previous cluster, a crosslink cluster, and the ground station. Given the size of a 3U CubeSat, the distance between each cluster, and the level of security that needs to be maintained between the 250 data links, multiple problems arise when considering the receiver/transmitter device design. The receiver needs to be large and robust enough to capture and direct the laser beam from these nanosatellites that undergo jitter and natural disturbances that reduce accuracy in pointing, yet small enough to fit within a CubeSat's 1U design frame. The receiver also has to be able to present itself to the transmitter satellite while remaining hidden to potential interfering parties. The main focus of my research will be to develop a compact and robust laser optical receiver that enables state of the art speed and security currently unavailable on nanosatellites due to cost and technology limitations**.** With the addition of the receiver, the proposed technology can be a secure alternative to the current leader in communications: underwater fiber optic cables. Underwater fiber optics cables have been eavesdropped and some-times cut by adversaries. In contrast, a space-based laser communication network offers point to point communication that cannot be easily intercepted/eavesdropped by a third-party. The optics required have been ordered and once they arrive tests on the system will commence with the goal of forming a communication link that can read photons per second, data rate and signal to noise ratio. This data will give a clear path as to how the system will be advanced and applied in the future. With successful application of this project the technology can be perfected and applied to deep space communications where it can unload a portion of the stress on the over-subscribed Deep Space Network.