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NOVEL BEAM STEERING APPLICATIONS FOR DRONE FSOC USING RISLEY PRISMS.

Abstract

Target acquisition and tracking of a drone for the purpose of Free Space Optical Communications (FSOC) requires fast and precise control. Risley prisms were explored as a solution to this problem, taking advantage of the mechanical simplicity of a dual stage Risley prism and its capacity to rapidly manipulate the direction of a laser beam. Atmospheric effects, notably atmospheric turbulence, is considered in this study. The study of FSOC with a drone has many aspects which relate to other real world applications and was a demonstrator for the capacity of Risley Prisms to be developed as common beam steering systems.

A simple beam steering system was created using two Risley Prisms with 10° angled faces. This system was then used to direct a 1064 nm laser to an optical sensor attached to the bottom of a small drone. The prisms would scan for the drone and once found would attempt to track it. Preliminary tests were performed with the drone attempting to hold stationary at a position within the optical systems field of view. These test were then expanded upon by having the drone follow a simple aerial pattern in the field of view. A radio link was established between the optical system and the drone to provide feedback required for the tracking.

During simple hovering operations, the Risley Prisms proved effective at maintaining the optical link with the drone. Whenever the link was broken due to small random movements of the drone, the optical system quickly and effectively re-acquired contact by utilizing a small spiral search. However, the optical link was often lost and was slow to re-establish when the drone followed a large, regular flight pattern.

The effectiveness of the drone at maintaining connection with the hovering drone indicated that Risley Prisms may be a good beam steering option. It is suspected that the failure to track the moving drone was more an issue with the developed controller and feedback rather than inherent limitations. Further development is planned for investigating new control algorithms and tracking techniques. It is proposed that the Risley Prisms could be combined with other control stages and/or different feedback techniques to greatly improve tracking capabilities.