Announcing the Final Examination of Sajad Saghaye Polkoo for the degree of Doctor of Philosophy in Physics

Date: April 4, 2022
Time: 2:00 p.m.
Room: Research I, 101
Dissertation title: IMAGING BASED BEAM STEERING FOR OPTICAL COMMUNICATION AND LIDAR APPLICATIONS

Abstract:
Optical beam steering is a key component in any application that requires dynamic (i.e. real-time control) of beam propagation through free-space. Example applications include remote sensing, spectroscopy, laser machining, targeting, LIDAR, optical wireless communications (OWC) and more. The pointing control requirements for many of these applications can be met by traditional mechanical steering techniques; however, these solutions tend to be bulky, slow, expensive, power hungry and prone to mechanical failures leading to short component lifetimes. Two emerging applications, LIDAR imaging and OWC, truly need improved beam-steering capabilities to flourish and support the advancement of self-driving cars or relieve the congestion in radio-frequency wireless networks, respectively. We consider the novel requirements of these applications during development of a new beam-steering technology.

We introduce imaging-based beam steering (IBBS) that uses an imaging transform between spatial and directional domains to implement a new method of electronic beam-steering. We introduce this concept while focusing on transmitters (Tx) for OWC but the pointing control mechanism is bi-directional supporting both transmit and receive functionality, even out of the same aperture; likewise, features that make this solution compelling for OWC are also great for LIDAR imaging. In IBBS, an array of high-speed sources are positioned at the focal plane of a lens and the lens passively collects, collimates and steers the beam into a conjugate direction. “Steering” is accomplished by selecting which source to use for an OWC link. This gives a coarse, pixelated beam-steering control that is well-suited for short-range OWC such as indoor communications and we present a prototype bulb for this application. Notably, multiple sources can be utilized at once with each steered into its conjugate directions and this presents the first beam-steering technology that supports multiple beams out of a single aperture; this feature uniquely supports multiplexed communications and fast, high-resolution LIDAR imaging.

Outline of Studies:
Major: Physics

Educational Career:
M. Sc. CREOL, College of Optics and Photonics, university of Central Florida, 2019
B. Sc. University of Guilan, Iran, 2008

Committee in Charge:
Dr. Dr. Christopher Kyle Renshaw (Chair)
Dr. Enrique Del Barco
Dr. Laurene Tetard
Dr. Sasan Fathpour (External Committee Member)

Approved for distribution. Dr. Christopher Kyle Renshaw, Committee Chair, on May 23th, 2022.

The public is welcome to attend.