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A MULTI-BEAM MULTI-LINK CAPABLE LASER COMMUNICATIONS TERMINAL FOR SMALL SATELLITES

Abstract

Free-space optical communication has proven to have many advantages over traditional radio communications. For instance, the hardware power efficiency and limited beam spread increase data rates for lower power consumption as well as decreased bandwidth crowing. Free-space optical communication is usually done through the use of laser communication terminals. In the past the main focus has been on increasing the data rates for a link and this has led to an exponential rise in the data rate performance. However, these modules have been limited to single beams and are hence capable of only one link. This decreases the number of users, networking and relay capabilities of optical communication satellites. The advent of MEMS micro-mirror arrays and reflective spatial modulators have allowed for compact and lightweight control of wavefronts. These applications would also allow for scalable independent steering of multiple laser beams. The Delft University of Technology is conducting a study of a compact and scalable multi-beam terminal through the use of these beam steering methods. The terminal consists of a MEMS micro-mirror array for high frequency response in the aperture with a high resolution reflective spatial modulator for the beam steering and shaping. This terminal is designed for spacecraft-to-ground and spacecraft-to-spacecraft duplex communications. Lab demonstrations are performed with at least 3 independent beams to determine its effectiveness at handling multiple beams, fiber coupling, combating independent jitter and offset angles among others. It is expected to support up to 10 or more duplex links in one terminal and, therefore, suitable for usage in small satellites and mega-constellations. The high resolution can also be used for sub-aperture wavefront correction in future. This paper discusses the design of the multi-beam terminal. It also presents the preliminary results of the lab demonstrations.