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PHASED ARRAY OPTICS IN FREE-SPACE OPTICAL COMMUNICATIONS SYSTEMS

Abstract

Free-space optical communications systems are a rapidly growing field as they carry many of the advantages of traditional fibre-based communications systems without the added investment of installing complex infrastructure. Moreover, these systems are finding key niches in mobile platforms in order to take advantage of the increased bandwidth over traditional RF systems. As an example, NASA has identified this technology as a suitable replacement for its aging Deep Space Network, a world-wide network of large-scale RF antennas used to communicate with NASA's fleet of deep space probes. In addition, both the Europeans and the Japanese have performed experiments in low Earth orbit involving multiple spacecraft using FSOC systems to communicate between the ground and each other. Clearly, in applications where time is limited for communications, bandwidth becomes a major consideration.

Of course, the inevitable problem of tracking arises when dealing with mobile stations. To compound the problem in the case of communications to low Earth or geosynchronous orbits, FSOC systems typically operate with tightly confined beams over great distances often requiring pointing accuracies on the order of micro-radians or smaller. Mechanisms such as gimbal mounts and fine-steering mirrors are the usual candidates for platform stabilization, however, these clearly have substantial power requirements and inflate the mass of the system. Phased array optics, on the other hand, offer a suitable alternative for beam-pointing stabilization. Some of the advantages of phased array optics over fine-steering mirrors include programmable multiple simultaneous beams, dynamic focus/defocus and moderate to excellent optical power handling capability.

The focus of this research will be on the use of phased array optics in an FSOC system communicating between a UAV and a satellite in geosynchronous orbit.