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Communications experiments via lasers began shortly after the invention of the first lasers. The technology of free-space optical communications (also known as laser communications or lasercom) has emerged to the point where it is now commonly used in terrestrial links, and by 2014 it will find operational use for bidirectional links with Earth-orbiting spacecraft. The technology of interplanetary optical communications is still maturing and is expected to be launch-ready later this decade. Narrow divergence of the transmitting laser beams owing to their shorter wavelength results in greater power density being delivered to the counter telecom terminal. The attraction of lasercom technology stems from taking advantage of the much enhanced power density at the receiver to consistently demonstrate one to two orders of magnitude greater data rate from the optical band over conventional radio-frequency (rf) telecommunications bands. This benefit is achieved with the same mass and power consumption and nearly one-tenth the transmit/receive aperture diameter as the rf systems. Other benefits include no current spectrum allocation issues due to virtually unlimited bandwidth, low interference, and secure communications due to the difficulty of jamming. This special section of *Optical Engineering* comprises six papers that cover developments in certain aspects of optical communications technology, providing insight into current areas of research.

The six papers in the special section fall into three categories:

Satellite communications: Gregory et al. summarize data for more than three years of successful communications links between two spacecraft in the low earth orbit (LEO). The commercial bidirectional links using a now-commercial flight payload are operating at 5.65 Gbit/s. Since the system uses coherent detection technology, links through the atmosphere to low-altitude ground stations are not possible without the use of adaptive optics (AO) technology on the ground station. Attempts to develop an AO system for the ground terminal to successfully link with the payload in LEO are also described. Efforts to develop a flight terminal for the geosynchronous orbit (GEO) for LEO-GEO links are also discussed.

Terrestrial communications: In a paper entitled "High-data-rate ground-to-train free-space optical communication system," Urabe et al. discuss concepts, protocols, and technology development efforts to communicate between stationary stations along a train path and high-speed trains passing by. The idea is to deliver high-bandwidth communications capability to train passengers.

Atmospheric characterization: Four papers describe atmospheric measurements and characterization that are compared with models for the optical channel, which is at times an impediment to achieving high-availability optical links. Reinhardt et al. describe atmospheric channel transfer function estimation from experimental free-space optical communications data. Arimoto presents data on operational conditions for direct single-mode-fiber coupled free-space optical terminal under strong atmospheric turbulence. Grabner, Kvicera, and Fiser discuss data on rain attenuation measurement and prediction on parallel 860-nm free space optical and 58-GHz millimeter wave paths. Finally, Khan et al. present further results on fog modeling for terrestrial free-space optical links.

Hamid Hemmati obtained a PhD in physics, studying laser spectroscopy of photodissociated molecules, followed by postdoctoral research at the National Institute of Standards and Technology in laser-cooled trapped ions for time and frequency standards. He then joined Allied Corp., working exclusively at the National Aeronautics and Space Administration's Goddard Space Flight Center, first on the COBE spacecraft and then on free-space optical communications. In 1986, he joined the Jet Propulsion Lab's Optical Communications Group, where he is now a principal member of the staff and a technical group supervisor. He has published more than 200 journal and conference papers and is the editor/coauthor of two books and four book chapters on optical communications. He is a fellow of SPIE and in 2011 received NASA's exceptional service medal.