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High-speed optical fiber communications architecture combining SDM and OAM based designs with PAM4 and WDM systems.

Syed H. Murshid
The Inventor of SDM & OAM in Optical Fibers,
Florida Institute of Technology, USA,
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KEYNOTE SPEAKER

Increasing total channel capacity in optical fiber communications and networking requires new approaches for transmission media. Optical communication system data rates can be substantially improved through new modulation and multiplexing techniques. Spatial domain multiplexing (SDM), also known as space-division multiplexing, can increase the bandwidth and spectral efficiency of optical fibers by order of magnitude or higher. It can support multiple channels of the same wavelength over a single fiber, where each channel follows a unique helical path inside the fiber core, and the channels do not interfere with each other. It is a multiple-input multipleoutput (MIMO) architecture that launches light from multiple laser sources of the same wavelength into a single carrier fiber at different angles. The resultant channels follow different helical trajectories while traversing the carrier fiber, thereby allowing spatial reuse of optical frequencies. The input launch angles determine the output's spatial characteristics by allocating a unique location to each channel. Each channel's energy density follows a different radial distribution, and adjacent channels do not exhibit any discernible crosstalk. Simple spatial filtering techniques are employed at the output end of the fiber to de-multiplex these channels. Helically propagating SDM channels also carry orbital angular momentum (OAM) of photons. Hence, clockwise and counter-clockwise OAMs can be independently generated. SDM and OAM add two new degrees of photon freedom to optical fiber multiplexing techniques and can complement existing multiplexing and modulation schemes, such as TDM, WDM/DWDM, and PAM4 achieve high-speed serial optical data transport. This endeavor presents a hybrid MIMO architecture that combines SDM and OAM over a single-core multimode carrier fiber. It also shows that the radial location of a given SDM channel output is independent of the light source's wavelength, thereby allowing integration of SDM and OAM based multiplexing techniques to WDM/DWDM networks. It also presents a Multi-Tb/s high-speed optical fiber communication architecture that combines spatial domain multiplexing and orbital angular momentum of photon-based multiplexing and complements wavelength division multiplexing as well as PAM4 modulation.

Keywords: Spatial domain multiplexing (SDM), space division multiplexing (SDM), orbital angular momentum (OAM), optical vortex, helical propagation, bandwidth increment, optical fiber communications, optical architecture, Multi Tb/s optical communications.

Biography

Syed H. Murshid is a Professor of Electrical and Computer Engineering at the Florida Institute of Technology in Melbourne, Florida. He teaches courses in optics and electrical engineering at both graduate and undergraduate levels. His research focuses on optical fiber communications and sensors. He is pushing the state-of-the-art in optical fiber bandwidth using hybrid optical architectures, and his contributions include adding two new degrees of photon freedom to optical fiber multiplexing techniques. As the inventor of SDM and OAM in optical fibers, he holds multiple patents to these technologies. His current research activities are focused on combining these technologies for communication architectures exceeding 100s of Tb/s.

Professor Murshid is an active researcher, and his endeavors regularly receive support from the government and industry. He disseminates his research results regularly in books, book chapters, peer-reviewed articles, and conference presentations. He also holds ten US and International patents. In November 2004, he was named one of Florida's five most influential scientists by the Florida Trend Magazine.

Murshid received BE in Electronics Engineering in 1986 from NED University of Engineering and Technology in Karachi and served the instrumentation and process industry until 1994 in different capacities that focused on design and maintenance of SCADA systems. He received MS in Electrical Engineering from the Florida Institute of Technology in 1995, followed by Ph.D. in Electrical Engineering in 1997. After a brief sojourn with Harbor Branch Oceanographic Research Institute, he returned to Florida Tech in 1999, where he currently teaches courses in electrical circuits, virtual instrumentation, photonics, fiber-optic communications, and fiber-optic sensors