over PPM, for the same number of dimensions, (measured at BER of $10^{-6}$) ranges from 0.67dB for $N = 2$ to 2.81 dB for $N = 8$. Moreover, the spectral efficiency, for the same number of dimensions, of ND-OAM is $N^2/\log_2 N$ times better. The proposed OAM-based schemes, therefore, represent the excellent candidates for next generation deep-space and near-Earth optical communications. In addition to next generation deep-space/near-Earth optical communication enabling technologies, we have described different approaches to deal with atmospheric turbulence induced OAM crosstalk including equalization, OAM-time coding, and adaptive modulation and coding.

Notice there is a significant effort to improve the result from [2] in terms coming closer to the channel capacity limits. Some researchers are trying to improve this result even for a fraction of dB. With the proposed scheme, however, we are able to outperform LDPC-coded PPM for even 2.81 dB for $N = 8$, and at the same time improve spectral efficiency 21 times (also for $N = 8$), indicating that the proposed scheme is a promising candidate for next generation deep-space and near-Earth optical communications.

Some other applications of interest of OAM-based systems described in this paper include: providing ultra-high-speed Internet connection, increasing data rate and reducing system cost and deployment time in access networks, enabling ground-to-satellite/satellite-to-ground FSO communications at high-speed, enabling ultrahigh-speed intersatellite communications, and possibly enabling aircraft-to-satellite/ satellite-to-aircraft high-data-rate communications.

**Acknowledgments**

This work was supported in part by the National Science Foundation (NSF) under Grants CCF-0952711 and ECCS-0725405.

#148481 - $15.00 USD Received 1 Jun 2011; revised 27 Jun 2011; accepted 29 Jun 2011; published 11 Jul 2011