Optical and Quantum Electronics (2022) 54:104
https://doi.org/10.1007/s11082-021-03476-9

Intrinsic signal processed non-linearity tolerant novel 2-Tier star constellation

Zahid G. Khaki[1,2] · **Gausia Qazi**[1]

Received: 2 August 2021 / Accepted: 18 December 2021

Abstract
In coherent optical systems, optical fiber non-linearity is a consistent limiting factor towards the effective signal-to-noise ratio though being mitigated by various digital signal processing based approaches. In this paper, an intrinsic method of signal processing based on the shape of the input constellation is employed to yield a novel non-linearity tolerant geometric constellation. 16-QAM back-to-back coherent system is optimized for minimum value of non-linear interference, and a novel 2-Tier star constellation using sequential quadratic programming algorithm is proposed. The values of second and fourth order moments of input obtained for the optimized 2-Tier star constellation are 1.19 and 1.70 respectively, resulting in an overall reduction of non-linear interference. The complexity of the system proposed is found to be minimal in comparison to the other existing systems employing digital compensation.

Keywords Constellation shaping · Geometric shaping · Sequential quadratic programming · Non-linearity mitigation · Non-linear interference noise · 16-Quadrature amplitude modulation

1 Introduction

The advent of high-speed digital signal processing has paved the way for coherent optical communication implementing spectral efficient and multi-level modulation formats, thereby increasing the channel capacity. The ever-growing traffic demands are being taken care of by optimal exploitation of the installed optical communication systems (Winzer et al. 2018). To keep up with the demand, various methods have been employed from time to time to exploit the system capacity to Shannon limit, which include advanced modulation formats (Nakazawa

✉ Zahid G. Khaki
xahid.khaki@islamicuniversity.edu.in

Gausia Qazi
gausia.qazi@nitsri.net

[1] Department of Electronics and Communication Engineering, National Institute of Technology, Srinagar 190006, India

[2] Department of Electronics and Communication Engineering, Islamic University of Science and Technology, 192122 Awantipora, Pulwama, India

Published online: 05 January 2022