Al-Sakkaf, A.G., Morales-Céspedes, M. Tangential Power Allocation NOMA scheme for Visible Light Communications. In: 2022 IEEE Conference on Standards for Communications and Networking (CSCN), 28-30 November 2022, Thessaloniki, Greece [proceedings]. IEEE, Feb. 2023, 1 p.

DOI: https://doi.org/10.1109/cscn57023.2022.10050911

Tangential Power Allocation NOMA scheme for Visible Light Communications

Ahmed Gaafar Al-Sakkaf, Máximo Morales-Céspedes
Department of Signal Theory and Communications. Universidad Carlos III de Madrid, Leganés, Spain
Email: {aasakkaf, maximo}@tsc.uc3m.es

***Abstract*—Non-orthogonal multiple access (NOMA) has been proposed in both radio-frequency (RF) and visible light communications (VLC) to both improve the achievable rate and overcome the constrains in the number of users of orthogonal multiple access (OMA) schemes. Despite the advantages of NOMA, there still exist some issues that require more investigation such as power allocation schemes. This is issue is more remarkable in VLC due to the small and confined coverage footprint of each optical access point. In this poster, we propose a novel methodology denoted by tangential power allocation (TPA) for NOMA in VLC. Basically, the power allocation coefficients are calculated based on the tangential point on the NOMA rate region that is parallel to the OMA region. It is shown that TPA achieves greater performance in terms of achievable rate and fairness in comparison with conventional NOMA schemes.**

I. Introduction and Background

Visible light communication (VLC) is a recent technology proposed for the next generation of wireless communication networks to move the indoor data traffic to the optical domain. The main advantage of VLC lies on the wide and unlicensed spectrum available in the optical domain and the lack of interference with RF systems. Experimentally, it is proven that light emitting diodes (LEDs) achieve data-rates up to Gbps [1], [2]. However, it is necessary to devise transmission scheme to exploit the potential of the LED technology.

In the last few years, non-orthogonal multiple access (NOMA) has been introduced in wireless communication systems to optimize the resource allocation and improve the achievable rate and fairness among users. According to [3], power domain NOMA is one of the possible future transmission schemes in the framework of the next generation multiple access (NGMA). Basically, NOMA schemes transmit to two or more users in the same resource (time/frequency) simultaneously, while allocating distinct power coefficients to each user. After that, each user decodes its intended symbol following successive interference cancellation (SIC).

II. Tangential power allocation for VLC-NOMA

For any two-users in a downlink system, the NOMA region corresponds to a concave curve while the OMA region represented is given by a straight line between the maximum rates of the near and far users as it is shown in Fig.1. The NOMA region depends on the channel gain differences of the users. It is worth noticing that there is a trade-off between the fairness and maximizing the average rate of the users. Tangential power allocation (TPA) coefficients can be represented by the farthest point in the NOMA region from the OMA region (see Fig. 1). The channel coefficients that obtain this constraint is denoted by the tangential point, which notice that it is parallel to the slope between points $R_{n(\max)}$ and $R_{f(\max)}$ (OMA region). That is,

$$\frac{R_{f(\max)}}{R_{n(\max)}} = \frac{\partial R_\Sigma}{\partial a_n}, \tag{1}$$

where R_Σ is the sum rate of the two users, a_n is power coefficient factor of the near user and, $R_{n(\max)}$ and $R_{f(\max)}$, are the maximum rates of the near and far users, respectively.

This work was funded by the European Union(EU) Horizon 2020 research and innovation program under the Marie Skłodowska-Curie ETN TeamUp5G, grant agreement No. 813391.

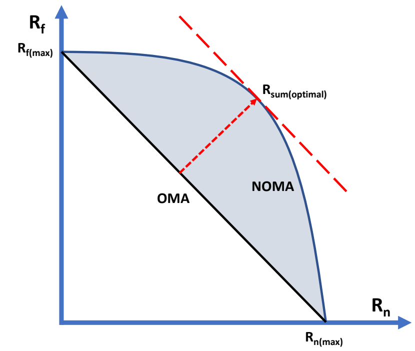

Fig. 1: The tangent point $R_{\text{sum(optimal)}}$ corresponds to the TPA scheme.

References

[1] B. Schrenk, M. Hofer, F. Laudenbach, H. Hübel and T. Zemen, ”Visible-Light Multi-Gb/s Transmission Based on Resonant Cavity LED With Optical Energy Feed,” in IEEE Journal on Selected Areas in Communications, vol. 36, no. 1, pp. 175-184, Jan. 2018, doi: 10.1109/JSAC.2017.2774578.

[2] D. Tsonev, S. Videv, and H. Haas, “Towards a 100 Gb/s visible light wireless access network,” Opt. Express, vol. 23, no. 2, pp. 1627–1637, Jan. 2015.

[3] Y. Liu et al., ”Evolution of NOMA Toward Next Generation Multiple Access (NGMA) for 6G,” in IEEE Journal on Selected Areas in Communications, vol. 40, no. 4, pp. 1037-1071, April 2022, doi: 10.1109/JSAC.2022.3145234. allocation in non-orthogonal multiple access for indoor visible light com- munication networks,” IEEE Access, vol. 7, pp. 15 250–15 261, 2019.