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Secrecy Sum-Rate of Multi-User MISO Visible Light Communication Systems with Confidential Messages

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Abstract

This paper studies the information theoretic secrecy sum-rate for multi-user multiple-input single-output (MU-MISO) visible light communication (VLC) systems with confidential messages. The well-known Zero-Forcing (ZF) precoding technique is employed to ensure confidentiality among legitimate users and, at the same time, to prevent eavesdropper(s) from obtaining any information. Different from radio frequency (RF) counterpart where the average input power constraint is usually imposed on the derivation of channel capacity, the input data signal of VLC systems is amplitude constrained, leading to a peak input power constraint. The amplitude constraint gives rise to the complexity in obtaining an analytical expression for the capacity. In this paper, we analytically investigate a novel bound on the secrecy sum-rate of all legitimate users in MU-MISO VLC systems, which is valid in high signal-to-noise ratio (SNR) regime. The secrecy sum-rate performance is then derived for two scenarios: known and unknown eavesdropper's channel state information (CSI) at the transmitter.

Keywords: VLC, multi-user MISO, physical layer security, ZF precoding.

1. Introduction

Over the past few years, it has been witnessed an explosion in research and development of visible light communication (VLC) technology in both academia and industry. As the demand for high data-rate wireless transmission continues to increase tremendously, VLC is an attractive solution to cope with the problem. Operating at unregulated and free frequencies, VLC also effectively addresses the spectrum scarcity problem in radio frequency (RF) systems [1–4].

Due to the fact that LEDs are practically used for both illumination and communications purposes, the employment of multiple-input multiple-output (MIMO) technique is a logical solution to increase the data-rate and the coverage of VLC systems [3–6]. As a natural progression for the single-user MIMO configuration, MIMO-VLC systems, especially its popular case of multi-input single-output (MISO) ones, supporting multiple users (MU) have recently received a great deal of attention. The popularity of MISO-VLC systems is due