High-Rate Full-Duplex Optical Wireless Data Transmission for Medical Applications
Jahid Hasan, Mohammad-Ali Khalighi, Jorge Garcia

To cite this version:
Jahid Hasan, Mohammad-Ali Khalighi, Jorge Garcia. High-Rate Full-Duplex Optical Wireless Data Transmission for Medical Applications. PhD Days 2019, Jun 2019, Marseille, France. hal-02572663

HAL Id: hal-02572663
https://hal.science/hal-02572663
Submitted on 13 May 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
High-Rate Full-Duplex Optical Wireless Data Transmission for Medical Applications

Jahid HASAN1,2, Ali KHALIGHI1, Jorge GARCIA2
1CNRS, Aix Marseille Université, Centrale Marseille, Institut Fresnel UMR 7249, 13013 Marseille, France
2Oledcomm SAS, 10-12 Avenue de l’Europe, 78140 Velizy-Villacoublay, France

Abstract: Health monitoring of aged people from a remote distance and continuous monitoring of patients in medical centers or hospitals is very crucial to avoid receiving wrong medical treatments. This can be accomplished by sending timely data from several medical devices via a wireless body-area network (WBAN). WBANs based on radiofrequency technology are susceptible to electromagnetic interference and potentially suffer from security concerns. Optical wireless communications (OWC) have evolved as a more appropriate technology for wireless data transfer within WBANs.

The main objective of this thesis is to design and develop a high-rate full-duplex transmission link for medical WBANs. We investigate OWC transmission between an access point (AP) and a number of users for downlink and uplink data communication. Particular attention is devoted to the suitable modulation and multiple access techniques insuring reliable data transmission in different use cases.

Wireless Body Area Networks

- Promising technology that provides a remote mechanism to monitor and collect a patient’s health record data using wearable sensors.
- Network architecture is classified as intra-WBAN (on-body communication between sensors and a hub) and extra-WBAN (communication between the hub and an external network or AP) [1].

Interest of Optical Wireless Communications

- Conventional RF-based WBANs are subject to electromagnetic interference in contrary to OWC-based ones.
- OWC networks are confined within the room boundaries, thereby enhancing security.
- OWC offers license-free huge unregulated spectrum.

OWC Transmission

- Data is transmitted using intensity modulation/direct detection.
- On-off keying is used (relatively low data rates are required: “Mbps at most”)
- Data can be received from both LOS and NLOS

Full-Duplex Transmission for Extra-WBAN

- We use visible-light communications (VLC) for downlink data transmission and infra-red communications (IR) for uplink.
- Hub or coordinator node is placed on the patient’s body consisting of an IR transmitter (LED) and a VLC receiver (photodiode).
- Focus is made on uplink (IR).
- The data collected by the hub from sensors are sent to the AP placed on the ceiling.

Multiple Access Techniques

- Need to handle multiple users in a room.
- Design of suitable multiple Access (MA) technique to manage multi-user interference.
- Classical MA techniques: FOMA, CDMA, CSMA.
- As OWC systems transmit real and non-negative information signals, such MA schemes (in their basic form) should be appropriately adapted to the optical domain.
- Our current work focusses on optical CDMA.

Summary

After defining typical use-cases for multiple patients in different medical applications, we are investigating appropriate MA techniques taking into account user mobility and changing position and studying their robustness and performance.

References


Acknowledgment

This work is supported by VisIoN, a European project funded by the European Union’s Horizon 2020 research and innovation program under the Marie Skłodowska-Curie Grant Agreement No. 764461.