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MAIN MENU

Home

About

Contact Information

Downloads and Information

Press

Projects

Publications

Students and Research Fellows

Teaching

Vacancies

External Links

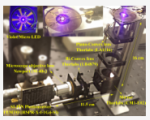
Latest Li-fi Research News

The latest Li-Fi Research and Development News from Professor Harald Haas.

The paper can be downloaded here

Modulation techniques for light fidelity (LiFi) are reviewed in this paper. LiFi is cellular wireless networking (re)using lights. Specifically, light emitting diodes (LEDs) are used in LiFi as visible light transmitters. This means future lighting systems fulfil two functions: high speed wireless networking and illumination. LiFi supports multiuser access and handover to enable mobile services. Since LED lights emit incoherent light only intensity modulation and direct detection can be used. Single carrier modulation techniques are straightforward to implement, but for data rates higher than about 15 Mbps computationally complex equalization techniques are required in frequency selective LiFi channels. Moreover, single carrier techniques suffer from DC wander effects. Alternatively, multicarrier modulation techniques offer a viable solution for high speed LiFi in terms of power efficiency, spectral efficiency and computational efficiency. In particular, orthogonal frequency division multiplexing (OFDM) based modulation techniques offer a practical solution as they are based on fast Fourier transformations for which very computational effective digital signal processing implementations exist. LiFi modulation techniques need to also satisfy illumination requirements. Flickering avoidance and dimming control are considered in the variant modulation techniques presented. This paper surveys the suitable modulation techniques for LiFi including those which explore time, frequency and colour domains.

The paper can be downloaded here.



Micro-sized Gallium Nitride (GaN) light emitting diodes (mirco-LEDs) are strong candidates for VLC (visible light communication) and LiFi (light fidelity) due to their high bandwidths. Segmented violet mirco-LEDs are reported in this work with electrical-to-optical bandwidths up to 655 MHz. An orthogonal frequency division multiplexing (OFDM) based VLC system with adaptive bit and energy loading is demonstrated and a data transmission rate of 11.95 Gb/s is achieved with a violet mirco-LED, when the nonlinear distortion of the mirco-LED is the dominant noise source of the VLC system. A record 7.91 b/s data transmission rate is reported below the forward error correction threshold using a single pixel of the segmented array when all the noise sources of the VLC system are present.

A number of inherently unipolar orthogonal frequency division multiplexing (OFDM) modulation schemes have been introduced recently in an attempt to improve the energy efficiency of OFDM-based intensity modulation and direct detection (IM/DD) systems.

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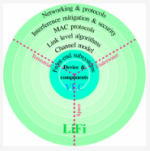
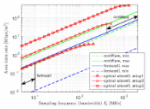


This is our extended ECOC 2015 and invited Journal of Lightwave Technology (JLT) paper. The paper can be downloaded from here.

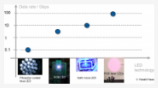
LiFi provides a completely new layer of wireless connectivity within existing heterogeneous radio frequency (RF) wireless networks. LiFi supports multiuser access and enables roaming. It is, therefore, a truly mobile system. Multisuer access and mobility support in LiFi require unique building blocks as outlined in the figure below. Techniques developed for RF systems cannot be applied direct as the signal propagation and information encoding techniques are different. However, the differences diminish as higher frequencies in RF are used such as mm wave bands. The paper also describes the first LiFi transmitter and receiver ASICs (application specific integrated circuits) developed at the University of Edinburgh as part of the UP-VLC project. These ASICs allow real-time data transmission of 1 Gbps as well as support multiple-input-multiple-output (MIMO) operation and wavelength division multiplexing (WDM). LiFi fulfils many key performance indicators (KPI) postulated for 5G systems.

DOI: 10.1109/JLT.2015.2511015



This our recently published paper on the downlink performance of optical attocell networks. The paper can be downloaded here.

This work shows that optical attocell networks can improve the area data rate of radio frequency based **femtocell networks** by up to **three orders of magnitude**. In addition a comparison with future **mm-wave** based **cellular networks** is provided, and it is shown that the are data rate can be **double** the one achieved with future mm wave cellular networks. The optical attocell networks are assumed to exploit the existing lighting infrastructure.

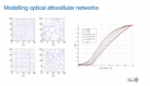


LiFi could transmit up to 100 Gbps and possibly higher, but this would require a change in lighting technology.

Recent news report that LiFi is 100 times faster than WiFi. The assumption was that the average WiFi speeds are 10 Mbps, and that LiFi can be as fast as 1 Gbps. It is important to highlight that 1 Gbps transmission speeds from an off-the-shelf commercial LED light bulb have not been demonstrated, yet. In this discussion, it is important to compare like-for-like.

Read the facts on Lifi in this article by Professor Harald Haas.

An invited talk at GreenComm 2015 can be downloaded here.



We have been invited to give a talk at the IEEE GreenComm 2015 truly online conference. The talk is entitled: "Can LiFi Enhance Energy Efficiency?" and is scheduled between 9:20am - 9:50am GMT on 11 November 2015. After the pre-recorded talk which can be watched through this link, I will be available for questions.

We have held a one day intensive workshop on LiFi.

Light-Fidelity (LiFi) takes visible light communication (VLC) further by using light emitting diodes (LEDs) to realise fully networked wireless systems.

Our latest research on load balancing in hybrid WiFi/LiFi networks has shown an interesting result: There is a direct relationship between WiFi throughput and LiFi throughput. Specifically, as the LiFi throughput increases, so does the WiFi throughput, and vice versa.