[1]LISV, Saint-Quentin University of Versailles, Vélizy, France

[2]Department of Computers, Electronics and Automation, Stefan cel Mare University Suceava, Romania

Evaluation of the noise effects on Visible Light Communications using Manchester and Miller coding

Authors:

Alin-M. Cailean[1,2], Barthélemy Cagneau[1], Luc Chassagne[1], Valentin Popa[2], Mihai Dimian[2]

Suceava, May 2014

Introduction to VLC

- Visible Light Communications (VLC) represents the usage of LEDs for both illumination and wireless data transmission;
- IEEE 802.15.7 draft standard (2011);
- World-wide unregulated, almost unlimited spectrum;
- High data rates (3 Gbps - 2014);
- Safe for the human body and for electronic equipment (unlike RF or IR);
- Omnipresent technology with reduced implementation cost;
- VLC in the Intelligent Transportation System (ITS).

2

VLC in the ITS

- I2V & V2V have the potential to address up to 81% of the traffic accidents.
- VLC is an alternative and/or a complement to RF based communication in several scenarios (e.g. high traffic densities lead to increased latencies, unacceptable for a reliable safety system).
- VLC could reduce the load on the RF channels;

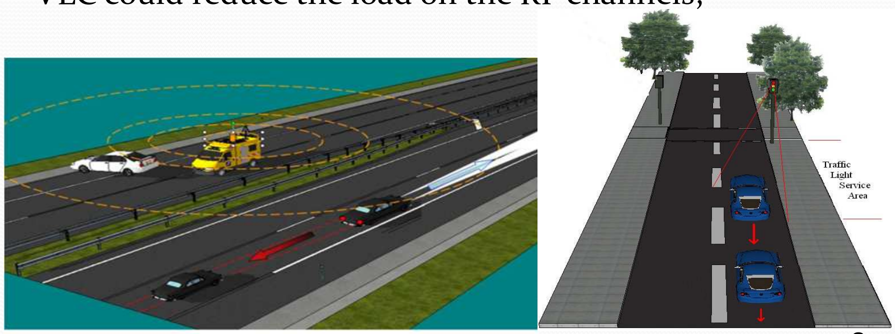

Fig. 1 – Scenarios for VLC usage in the ITS

3

VLC modulations and coding

- Intensity Modulation with Direct Detection;
- IEEE 802.15.7 specifies for outdoor application (PHY I) the usage of OOK or VPPM;
- OOK with Manchester coding (11.67 – 100 kbps);
- Miller code seems better suited for MIMO applications (Fig. 2);

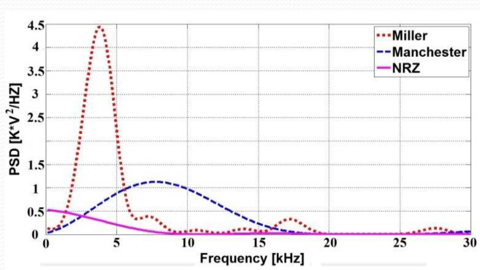

Fig. 2 – PSD for NRZ, Manchester and Miller code at 11.67 kHz

4

Proposed VLC architecture

- VLC performances are strongly influenced by the communication channel (Fig. 3);
- Signal Independent White Gaussian Noise;

$$Y(t) = RX(t) \otimes h(t) + N_{Total}(t) \quad (1)$$

$$N_{Total} = \sqrt{N_{shot}^{2} + N_{thermal}^{2}} \quad (2)$$

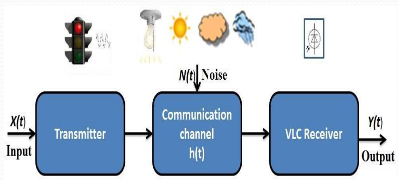

Fig. 3 – Simplified VLC channel model.

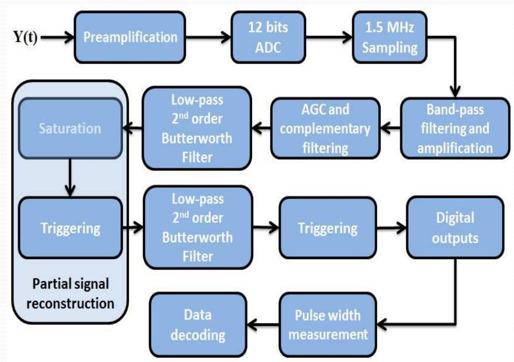

Fig. 4 – VLC receiver architecture model.

Simulation results – pulse distortions

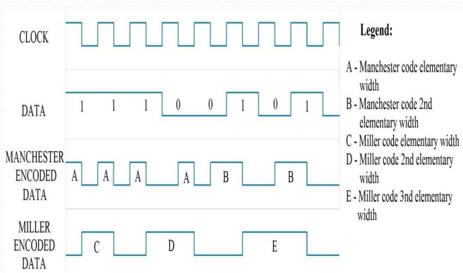

Fig. 5 – Possible pulse widths

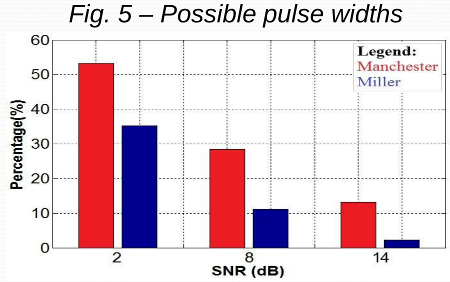

Fig. 6 – Pulse widths with distortion > 5%

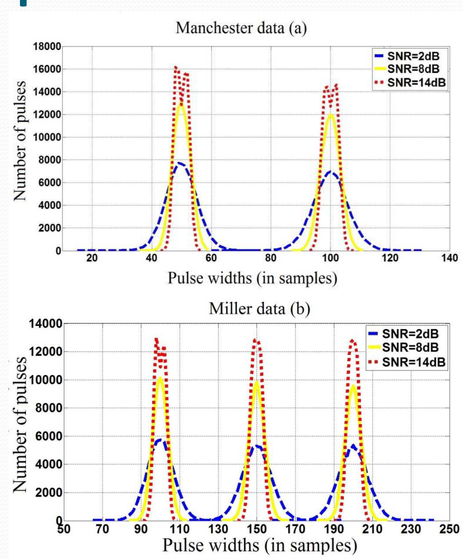

Fig. 7 – Pulse widths

6

BER Simulation results

- A digital data frame has been defined (Fig. 8);
- The BER performances of the VLC link are evaluated;

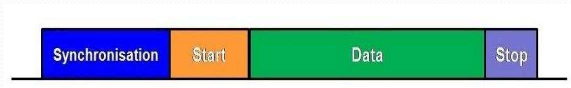

Fig. 8 – Structure of the data frame

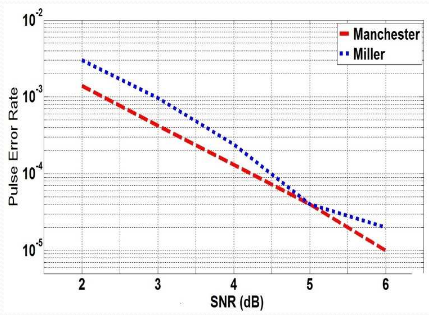

Fig. 9 – Pulse Error Ratio

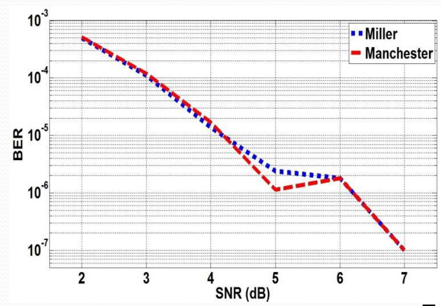

Fig. 10 – Bit Error Ratio

Experimental Results

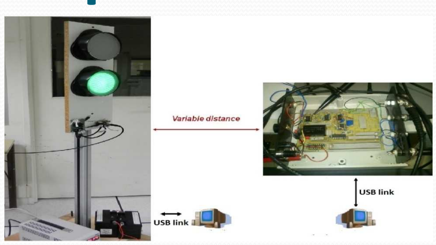

Fig. 11 – Hardware VLC system

- The similar performances of the two codes are experimentally confirmed;
- Analogic signal reconstruction;

Table I – Results at a 15 kHz modulation frequency

Emitter-Receiver Distance	Data coding	BER	Testing conditions
1 – 50 m	Manchester Miller	$<10^{-7}$	Outdoor with daylight
1-20 m	Manchester Miller	$<10^{-7}$	Indoor with artificial light

Conclusions

- A VLC receiver architecture was proposed;
- An analysis over the noise effect on Manchester/Miller coded VLC signals was performed;
- The manner in which the noise affects the BER;
- The two codes had similar BER results;
- Since the Manchester and the Miller codes are similar in BER performances, but the latter has better channel usage, we can state that the Manchester code is adequate for single channel communications, whereas the Miller code is better suited for MIMO applications.
- As future work, we plan to improve the proposed receiver architecture, to implement it on a hardware DSP system and to test it in real conditions.

Evaluation of the noise effects on Visible Light Communications using Manchester and Miller coding

Thank you!

Questions?

- Acknowledgement - This work was supported in part by the University of Versailles Saint-Quentin and Valeo Industry. A part of the financial support is granted by the Fond Unique Interminsteriel (FUI) project named Co-Drive, supported by the Pôle de Compétitivité Mov'eo. Alin-Mihai Cailean was supported by the project "Sustainable performance in doctoral and post-doctoral research PERFORM - Contract no. POSDRU/159/1.5/S/138963", project co-funded from European Social Fund through Sectorial Operational Program Human Resources 2007-2013.

CONTENTS

SECTION A - Systems, Process Control and Automations

SECTION B - Communications and Computer Networks

SECTION C - Electronics and Computer Aided Engineering

SECTION D - Software Engineering and Information Technologies

**The 12th International Conference on
Development and Application Systems
DAS 2014**

**May 15-17, 2014
Suceava - Romania**

www.dasconference.ro

Conference Program

Organized by

**Stefan cel Mare University of Suceava
Faculty of Electrical Engineering
and Computer Science**

With technical sponsorship from

**IEEE Industry Applications Society, Romania Section
IEEE Conference Record #33969**

The 12th International Conference on **Development and Application Systems** (DAS), organized biennially by *the Faculty of Electrical Engineering and Computer Science, Ştefan cel Mare University of Suceava*, has four sections:

A - Systems, Process Control and Automations

B - Communications and Computer Networks

C - Electronics and Computer Aided Engineering

D - Software Engineering and Information Technologies

The scope of the Conference is to bring together specialists from universities, research institutes and companies for useful ideas exchanges regarding concerns in their domains. The latest progresses in these fields, as well as the newest scientific and technical results, will be presented and discussed during the Conference.

Participant registration will take place in Building D, first Floor, on May 15 between 9:00 AM and 7:00 PM and on May 16, between 8:00 AM and 9:30 AM.

CONTACT INFORMATION

Phone:	+(40)-230-524-801
Phone:	+(40)-744-429-378
Phone:	+(40)-745-594-640
Fax:	+(40)-230-524-801
Web:	www.dasconference.ro
E-mail:	das@eed.usv.ro

Paper ID: 39
Sensors Network Based on Mobile Robots
Victor ABABII, Viorica SUDACEVSCHI, Marin PODUBNII, Irina COJUHARI
Technical University of Moldova, Chişinău, Republic of Moldova

Paper ID: 43
Using dual priority scheduling to improve the resource utilization in the nMPRA microcontrollers
Nicoleta Cristina GAITAN, Lucian ANDRIES
Ştefan cel Mare University of Suceava, Romania

Paper ID: 44
Introducing aceMote: an energy efficient 32 bit mote
Andrei STAN, Nicolae BOTEZATU
Gheorghe Asachi Technical University of Iaşi, Romania

Paper ID: 48
Evaluation of the noise effects on Visible Light Communications using Manchester and Miller coding
Alin-Mihai CAILEAN[1,2], Barthelemy CAGNEAU[2], Luc CHASSAGNE[2], Valentin POPA[1] , Mihai DIMIAN[1]
[1] University of Versailles Saint-Quentin, Vélizy, France
[2] Ştefan cel Mare University of Suceava, Romania

Paper ID: 53
Implementation and Performance Analysis of Zero Forcing MIMO Detection Algorithm
Vakulabharanam RAMAKRISHNA[1], Tipparti Anil KUMAR[2]
[1] Department of Electronics & Communication Engineering, JNTUH, Hyderabad, India
[2] Department of Electronics & Communication Engineering, SR Engineering College, Warangal, India

Paper ID: 58
Design of a multi-input-multiple-output visible light communication system for transport infrastructure to vehicle communication
Lucian-Nicolae COJOCARIU, Valentin POPA
Ştefan cel Mare University of Suceava, Romania

Current Folder: **INBOX** Sign Out

Compose Addresses Folders Options Search Help FIESC

Message List | Unread | Delete Previous | Next Forward | Forward as Attachment | Reply | Reply All

Subject: [DAS2014] Your submission ID:48 has been accepted!
From: "DAS2014" <eugen.coca@usv.ro>
Date: Sat, April 26, 2014 11:45 am
To: alinc@eed.usv.ro
Priority: Normal
Options: View Full Header | View Printable Version | Download this as a file | View Message Details

On behalf of the Development and Application Systems International Conference, I am pleased to inform you that your submission with the ID:48, titled:

"Evaluation of the noise effects on Visible Light Communications using Manchester and Miller coding"

has been accepted.

Details about the registration process, payment of the conference fee and final paper version may be found on the Conference website at:

http://www.dasconference.ro

Congratulations,
DAS2014 - Program Committee Chair
Prof. Adrian GRAUR

Delete & Prev | Unread & Prev | Unread & Next | Delete & Next

Move to: INBOX Move