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Modelling noise and pulse width modulation interference in indoor visible light communication channels

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Abstract

Visible light communication (VLC) has the potential to supplement the growing demand for wireless connectivity. In order to achieve the full potential of VLC, channel models are required. Discrete channel models based on semi-hidden Markov models (Fritchman model) for indoor VLC using low data rate LEDs are presented. Each channel considered includes background noise and differing types of interference from fluorescent lights and pulse-width modulated (PWM) LEDs, which could be part of an indoor smart lighting system. Models were developed based on experimental error sequences from a VLC system using an on-off keying (OOK) modulation scheme. The error sequences were input into the Baum-Welch algorithm to determine the model parameters by expectation maximisation. Simulated error sequences generated by the models are compared to and, in most cases, perform better than simpler models with a single bit error rate. The models closely approximate the experimental errors sequences in terms of error distribution. The models performed better in channels where there is less interference. It was also found that periodic errors were introduced as a results of the PWM modulated smart lighting LEDs. These models have use for designing error control codes and simulating indoor VLC environments with different types of interference.