Abstract

Despite efforts to improve the efficiency and the spacial reuse of the ubiquitous RF frequencies range, the RF spectrum suffers from several issues, namely spectrum congestion and lack of bandwidth for future technologies such as 5G. Visible light communication (VLC) is a wireless technology that uses light as medium of communication. With light emitting diodes (LEDs) lighting becoming common, it is a natural extension of the lighting technology to modulate the LEDs at high speed to enable potentially high bandwidth downlinks.

Higher bandwidth becomes a major challenge in the development and implementation of VLC systems as transmission rates increase. One way of increasing bandwidth is through wavelength division multiplexing (WDM) in multicarrier systems that use red, green and blue (RGB) light emitting diodes to produce white light. However, these systems often suffer from low performance because of crosstalk interference, mainly caused by the imperfect nature of optical filters used to discriminate between the colours. The current research project aims to study the effects of optimal transmitter power control on the performance of WDM RGB-LEDs VLC systems. The research investigates both centralized and distributed scenarios, using the water-filling algorithm and the Refereed Game Theory to mitigate the interference between the different light colour carriers.

Results for the centralized power control show that by using mathematical models that take into consideration the effects of optical filters used for detection of colour signals, one is able to predict the trends in the overall system's performance. This enables us to adequately, determine the optimal power levels in the red and blue channels that result in the best overall performance of the system. This information is then used to formulate a distributed optimization power control scheme based on the Refereed Game Theory, which shows that cooperation between colour carriers to minimize crosstalk can be enforced by introducing a referee.