Abstract

The thesis primarily focuses on Underwater Optical Wireless Communications (UOWC), a unique and powerful means of utilising optical signals to transmit information through underwater wireless connections. UOWC complements radio-frequency (RF) and acoustic communication, particularly for establishing ultra-high-speed links in underwater environments covering short to medium distances. Nevertheless, challenges must be addressed to create a secure and dependable connection. Hence, a comprehensive understanding of light propagation in the underwater medium is crucial.

The core mission of this thesis is to delve into the impact of various elements within the underwater channel on the propagation of light. This study focuses on factors such as attenuation due to absorption and scattering losses, salinity and air bubbles, and noises, encompassing input-independent and input-dependent noise. The dissertation takes an information-theoretic approach, deriving channel capacity bounds to achieve this. In this research, the UOWC point-to-point link is modelled as intensity modulation with direct-detection (IM/DD) channels with potential interference from various underwater components, paving the way for practical applications in the field.

Following an in-depth exploration of UOWC system capacities across various scenarios, the thesis successfully designs a high-capacity and cost-effective UOWC system by incorporating Spectrum-Sliced Wavelength-Division Multiplexing (SS-WDM) technology. In the concluding section, machine learning algorithms are employed to forecast the system's performance. Additionally, the thesis examines the influence of diverse system parameters on the performance of the UOWC system.