# ABSTRACT

Recently, Optical Orthogonal Frequency-Division Multiplexing (O-OFDM) technique has been introduced in advanced Passive Optical Networks (PONs) to meet the increasing data traffic demand. The PON uses an optical splitter to distribute the downstream data among the users. Thus, the user data can be easily eavesdropped by an illegal user and may result in information leakage. Further, OFDM has high Peak-to-Average Power Ratio (PAPR) due to its multi-subcarrier modulation scheme and this causes spectrum spread and signal distortion. To solve these problems, researchers have proposed Three-Dimensional (3D) and Four-Dimensional (4D) chaotic physical-layer security schemes for Direct-Detection (DD) OFDM-PONs with PAPR reduction capability. This thesis proposes the application of two Seven-Dimensional (7D) chaotic systems to enhance the security and reduce the PAPR for both DD and coherent OFDM-PONs.

Two 7D chaotic schemes are proposed for secure transmission of both direct detection and coherent Giga bit per second (Gbps) OFDM-PONs. The first scheme is a hybrid one which combines two lower-order chaotic dynamics originated by 3D and 4D Subchaotic Systems (SCSs). The 3D SCS introduces chaotic constellation shifting while the 4D SCS produces chaotic Discrete Hartley Transform (DHT) precoding to increase the security level and decrease PAPR of the OFDM symbols. The second proposed scheme is based on a single 7D chaotic dynamic system. Three and four of the seven chaotic sequence variables are used to introduce chaotic constellation mapping and chaotic DHT precoding, respectively. Both 7D chaotic schemes are implemented in Matlab 2018 (ver. 9.5) to generate chaotic OFDM modulator and demodulator which are used as library elements in Optisystem ver. 15.1. Simulation is performed for up to 40 Gbps PONs and the results reveal that the proposed chaotic schemes offer high-security level without affecting the transmission performance of DD and coherent OFDM-PONs. The simulation results showed that the key space of the proposed system is $10^{3415}$.