ABSTRACT

This thesis proposes a quantum machine learning (QML) technique for demapping irregular circular QAM modulations for 5.5G and beyond. Future modulation trends are going beyond 1024-QAM, especially for Wireless-Fidelity (Wi-Fi), whose complexity is toward to exponential. Machine learning offers the potential to accelerate the learning of detection patterns from received signals, while quantum superposition enables parallel computation. The integration of these two approaches presents a promising strategy for handling irregular modulation schemes.

This thesis uses amplitude encoding technique to decode the input dataset or transmitted information symbol. Then, a Hadamard gate is used to create qubits in a superposition state. This thesis utilizes the empty states to observe the probabilities of the designed qubits for a given signal. As the final step, this thesis determines the bit based on the smallest probability obtained from the amplitude of the quantum states.

The results of this thesis show that (i) The proposed QML-based technique for demapping of QAM modulation schemes has reduced the minimum required qubits compared with previous research, (ii) The proposed technique only requires a minimum of 3 qubits to perform the demapping of C-BPSK modulation using amplitude encoding. We require of $3+m$ qubits for modulation order higher than C-BPSK with m is the modulation order, (iii) the proposed technique algorithm for QML-based demapping has a similar BER performance with the classical technique algorithm, (iv) this thesis has shown that the estimated time processing of the proposed technique algorithm with QML-based demapping is smaller than classical demapping techniques especially for $M \geq 8$, and (v) we has proposed high order irregular circular for 1024, 2048, 4096, and 8192 QAM and demapped with the proposed QML-based technique. The proposed technique is expected to be applied to beyond fifth-generation (5G) technologies that require high data rates and low latency. The results of this thesis are also expected to be useful for the development of sixth generation (6G) technology.

Keywords: modulation, nearest-neighbour classifier, quantum machine learning.