

PREFACE

An artificial neural network is usually a computational network which is based on biological neural networks that construct the structure of the human brain. These networks are composed of layers of inter-connected nodes, with each node representing a neuron. Every node is connected to other nodes in the network, allowing information to be transmitted from one to another. The nodes are also able to learn and adapt based on input data. Artificial neural networks(ANNs) also have neurons those are inter-connected to one another in various layers of the networks. In the mathematical implementation of neural networks, the stability and synchronization analyses of the mathematical models are very crucial. Moreover, ANNs based on machine learning models and especially deep learning models have been widely applied in computer vision, signal processing, wireless communications, and many other domains, where complex numbers occur either naturally or by design. However, most of the current implementations of ANNs and machine learning frameworks are using real numbers rather than complex numbers. There are growing interests in building ANNs using complex numbers, and exploring the potential advantages of the so-called complex-valued neural networks (CVNNs) over their real-valued counterparts.

There are six chapters in the present thesis. ANNs are introduced from motivation to designate and model in the beginning of this thesis. The architectures of the distinct neural networks such as Hopfield, Complex-valued, and Memristor based neural networks, are briefly discussed along with their modeling into mathematical equations. To conclude the introductory chapter, all the mathematical tools are introduced, which will be used throughout the chapters. The first problem is studied in second chapter in which the global exponential synchronization of complex-valued

recurrent neural network(CVRNN) is investigated in presence of uncertainty. In the third chapter, the problem is extended to the global quasi-synchronization of complex-valued recurrent neural networks with interaction terms. In the fourth chapter, a study of quasi-projective synchronization on memristor based CVRNN model has been presented. Again, in the fifth chapter, same synchronization analysis on second ordered model of CVRNN is studied.

In the last chapter, the future work is discussed which will be the extension of the results obtained in this thesis.
