

Treat Opaqueness of HHFNNs via Rule Extraction Using
GA for CVDs Diagnosis

by

Cui Yuanlian

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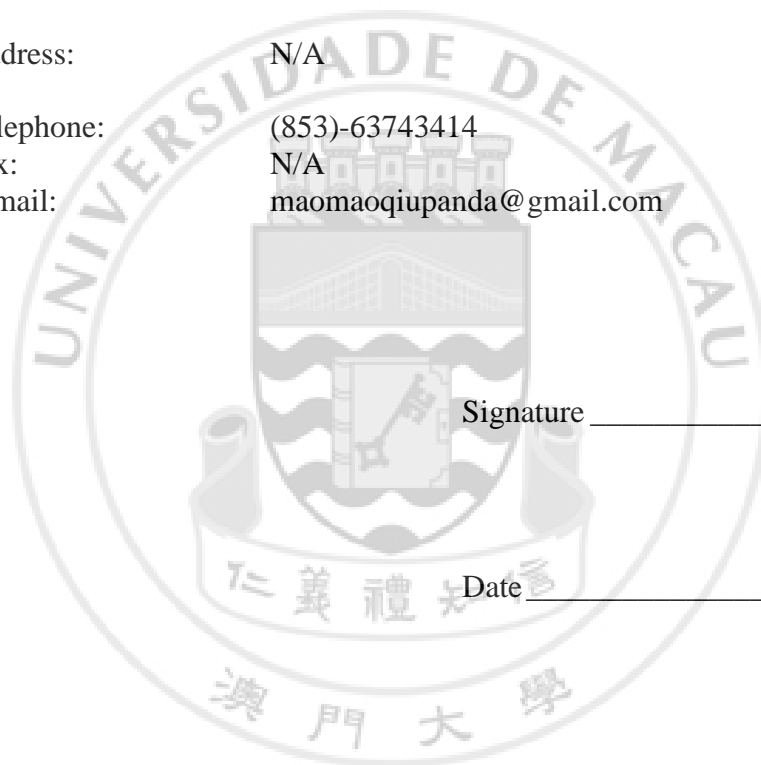
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Abstract

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by Cui Yuanlian

Thesis Supervisor: Prof. Dong Mingchui

Department of Electrical and Computer Engineering

Nowadays, e-home healthcare becomes a very hot topic and draws great attention. Cardiovascular diseases (CVDs) are responsible for over 17.3 million deaths per year and are the leading causes of death in the world. Therefore developing an e-home system for diagnosing CVDs is of great importance and in demand.

Hemodynamic parameters (HDPs) can be obtained through analysis of the sphygmogram curves which are easy to sample from human wrist and have abundant physiological information. A hierarchical system combining fuzzy logic and artificial neural networks (ANNs) for CVDs diagnosis through three grouped HDPs with different confidence coefficients was proposed by our research team few years ago and proved its high diagnostic accuracy.

However, neural networks (NNs) regarded as opaque models represent knowledge in digitized form in their hidden nodes and link weight matrix, which is not-understandable by human and leads to their rather low degree of comprehension. My thesis research mainly focuses on redressing the opaqueness of NNs and proposes an approach of providing exclusive explanation to the final result generated by hierarchical heterogeneous fuzzy NNs (HHFNNs).

There are several different methods in literature developed for providing such explanation capability for NNs. Among them, the means, called extraction rules from trained NNs, is accepted as the best way of extracting the knowledge represented in the NNs. The means of deriving an explanation structure from trained NNs that can give users insight into the decision-making processes of the trained NNs, thus allows users to verify what clinically sound basis is utilized by NNs for making decisions. And the rules created at the end are more understandable for human than any other representation (i.e. decision trees, semantic networks or directional graphs etc.).

Rule extraction from trained HHFNNs is proposed for CVDs diagnosis. Since the HHFNNs are composed of two types of NNs, the comparatively delicate structure implies a relatively universal rule extraction approach. Thus a pedagogical method of extracting fuzzy IF-THEN rules using genetic algorithm (GA) is proposed, which treats NNs as black boxes and is independent of NNs' architecture and training algorithm. The proposed method is verified using real clinical site-sampled data and the results tend to be acceptable.

Key words: hierarchical heterogeneous fuzzy neural networks, fuzzy logic, rule extraction, genetic algorithm, fuzzy IF-THEN rules

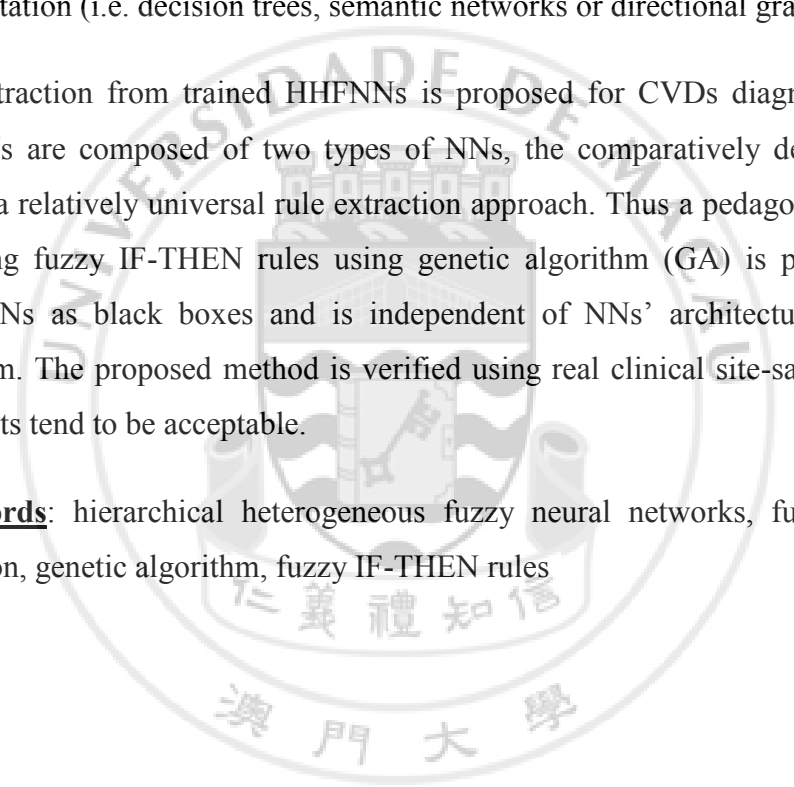


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LIST OF ABBREVIATIONS

AI. Artificial Intelligence

ANNs. Artificial Neural Networks

BP. Back-propagation

CVDs. Cardiovascular Diseases

DFA. Deterministic Finite-state Automata

ES. Expert System

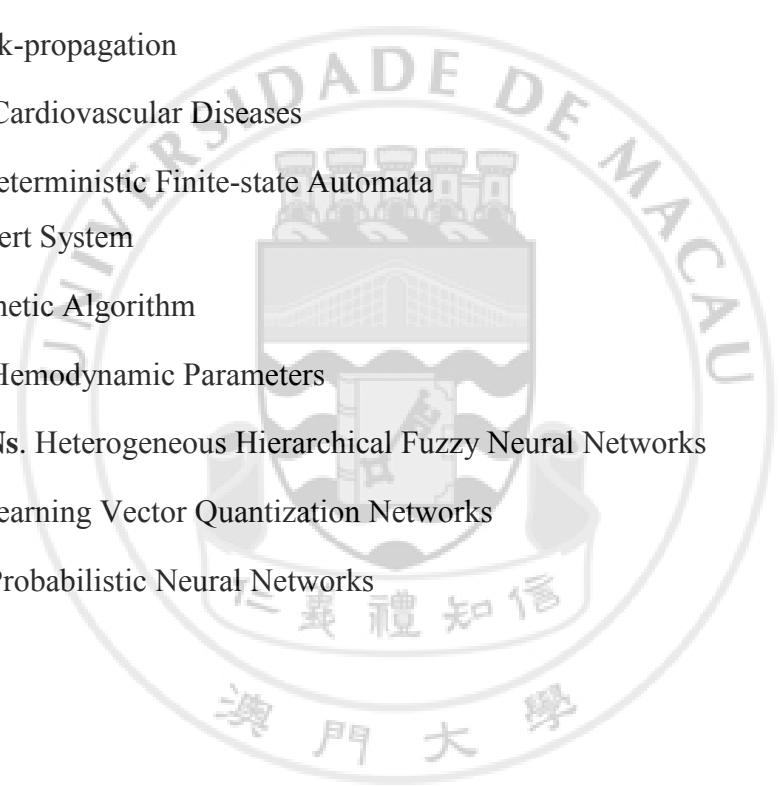
GA. Genetic Algorithm

HDPs. Hemodynamic Parameters

HHFNNS. Heterogeneous Hierarchical Fuzzy Neural Networks

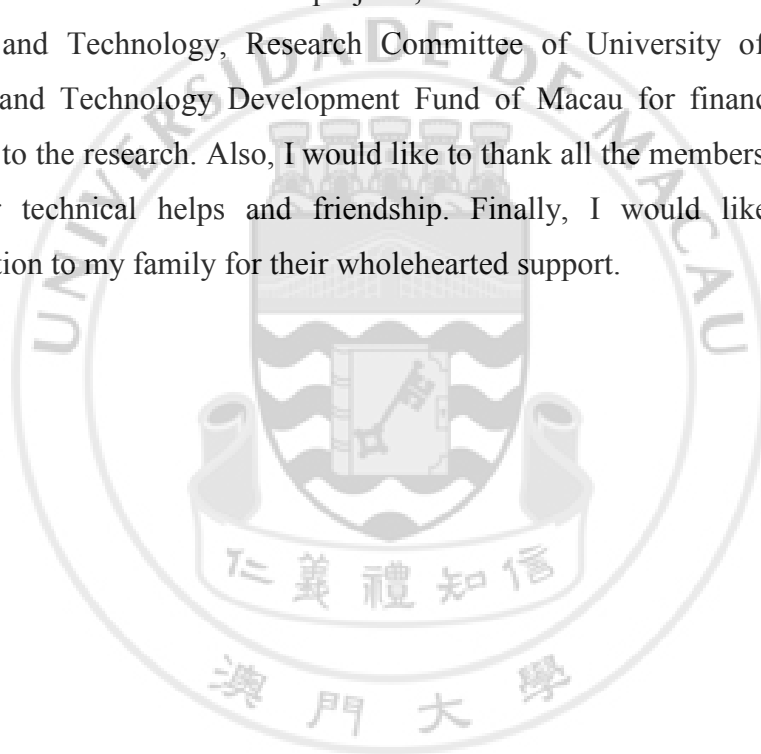
LVQ. Learning Vector Quantization Networks

PNNs. Probabilistic Neural Networks



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DEDICATION

The author wishes to dedicate this thesis to my mother.

Thanks for all she bestowed to me!

