Noise Immunization of a Neural Fuzzy Intelligent Recognition System by the use of Feature and Rule Extraction Technique

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ABSTRACT
The performance of a neural fuzzy intelligent recognition system (NFIRS) which recognizes varied levels of noise-corrupted characters was investigated in this paper. The number of regions in the universe of discourse of the input space was first arbitrarily selected. Then, the centers of these regions were self-organized by feeding the system with 256-pixel alphabet and algebraic training samples to the Kohonen competitive learning network. Based on the reallocated centers, we tried several combinations of varied rule-region product in order to generate a smaller set of fuzzy rules. We fixed the number of features to simplify and simulation and to isolate the effect of rule extraction. Simulation results showed an NFIRS that uses a set of thirty six sampling data set as the training input will generate a set of thirty six if-then fuzzy rules which can be used to recognize a corrupted testing data set without sacrifice the rate of recognition under varied conditions.

INTRODUCTION
In the last decade, artificial neural network has been applied to many real world applications such as washing machine, robot vision, automatic guide vehicle, and industrial inspection systems[1,2]. It is interesting that most of them are supervised learning networks. Reasons behind this partially comes from the fact that unsupervised neural networks, such as self-organized map networks, are not quite as easy to be accepted as back-propagation networks, and the unsupervised network needs large amount of raw data. In this paper, we first improve this situation by implementing a neural fuzzy intelligent recognition system [3] which can greatly enhance the understanding of an unsupervised neural network while keep nearly the same level of classifying capability with a self-generated fuzzy knowledge base. Then we test the integrity of this combination by a character recognition problem. Character recognition problems have been researched a lot in the past twenty years[5]. One important job of the recognition problem is to extract representing features from the input sampling data. Earlier literature on this subject can be classified into two major approaches[6,7]: 1) by a direct translation of a clustering network, and 2) by an indirect translation of a clustering network via a mapping network. The former forms its cluster patterns by a symbolic pattern extractor; while the latter needs a mapping network and a post-processing...
system basically is a two stage, hierarchical, unsupervised neural fuzzy combination. By taking the advantages of both the competitive network and a knowledge base system, we achieved a 36-rule and 4-region intelligent system which can recognize 60% of noise corrupted characters under a 30% of noise level. The rule base can be further reduced down to 32 rules in a experimental trial, however, the result degraded. Our simulation indicates that an optimized product of number of rule and number of region is possible. It is worthy the effort to research on the topic in the future.

REFERENCE

APPENDIX
PART A: Extracted rules for numeric characters

Rule #1:
If r1[388, 140]_Dist. AND
r2[368, 166]_Dist. AND
r1[420, 320]_Dist. AND
r2[338, 314]_Dist. THEN '0'

Rule #2-#10 are omitted:

PART B: Extracted rules for alphabet characters

Rule #1:
If r1[420, 127]_Dist. AND
r2[532, 133]_Dist. AND
r1[379, 259]_Dist. AND
r2[571, 234]_Dist. THEN

Rule #2-#26 are also omitted:

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