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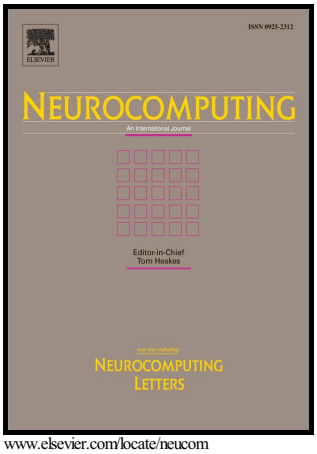

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Wavelet Fuzzy Cognitive Maps

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Abstract

Fuzzy cognitive maps (FCMs) are fuzzy influence graphs which consist of concepts and weighted edges. Various transfer functions have been applied in modelling and simulating the dynamic system of FCMs. In FCMs, transfer function is used to bound the expression level of nodes to a certain range. Therefore, in this paper, we first use wavelet transfer function, and then combine it with FCMs to form wavelet FCMs (WFCM). The wavelet function is a kind of local functions that has limited duration and an average value of zero. Then, we conduct comprehensive analyses over existing transfer functions using synthetic data, real data and pattern classification problems. Finally, according to analysis, a new method involving the selection of transfer functions in the optimization process for pattern classification problems is proposed. The experimental results demonstrate the effectiveness of the proposed method. Still, findings show how the existing functions offer different capacities to deal with both problems.

Keywords: Fuzzy cognitive maps, Wavelet, Pattern classification.

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1. Introduction

Fuzzy cognitive maps (FCMs) [1], integrating main aspects of fuzzy logic and neural networks, are a kind of effective tools for modelling complex systems and supporting decisions. An FCM represents fuzzy-graph representing causal reasoning which consists of a collection of nodes and directed weighted edges. The nodes in the graph stand for real world concepts (variables, attributes etc.) and weighted edges represent the relationships between nodes. The causal relationships among nodes can be determined by experts' knowledge or by historical data. FCMs have several advantages in comparison to traditional modelling techniques such as expert systems and neural networks [14] in terms of abstraction, flexibility, adaptability, and fuzzy reasoning. Therefore, FCMs have been developed and applied in a variety of applications, i.e., time series analysis [2, 3], control [4], medical diagnosis [5]-[7], [33], political and social sciences [8], business [9], [32], and information technology [10].

As an important part of FCM, transfer function is used to force the unbounded weighted sum to be monotonically mapped in to a normalized range. Bueno *et al.* [11] discussed four transfer functions using the same decisional model. Findings show how sigmoid function

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