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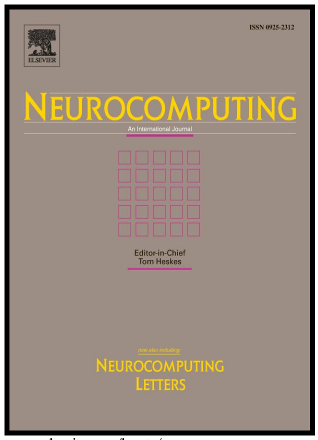

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CONTINUOUSLY SELF-ADJUSTING FUZZY COGNITIVE MAP WITH SEMI-AUTONOMOUS CONCEPTS

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ABSTRACT – Fuzzy cognitive maps (FCMs) are distributed computation systems used for qualitative modelling and behaviour simulation. Constructing an FCM is a time-consuming process and the quality of the resulting map is difficult to assess. In this paper we propose an extension to FCMs that self-adjusts the FCM based on real data from the modelled system. The self-adjusting FCM (SAFCM) changes the cause–effect relationships and concept inferences for each system data point with the goal of reducing the error between real data and values produced by the map. In this way, the burden of map construction imposed on the map builder is reduced and the initially constructed map can be evaluated by examining the degree of change caused by the self-adjustment. We tested the SAFCM on two case studies where we measured the degree of change to the initial map structure set up by an expert. The experiments showed that the self-adjusted maps produced results that were closer to real data than the maps that were initially set up by the expert. We also compared the SAFCM to a basic FCM and to an FCM that used a standard learning algorithm. The results showed that our algorithm had higher accuracy.

Keywords: self-adjusting fuzzy cognitive map, multi-agent systems

1. INTRODUCTION

Capturing, representing, formalizing, and using knowledge is a common task required in many domains. Different methods and techniques, among them Fuzzy Cognitive Maps (FCMs) based on non-symbolic knowledge representation and causal reasoning, are developed for different types of knowledge management applications. FCMs are a powerful modelling, simulation, and representation technique that can be used for decision support, strategic planning, and prediction.

FCMs are a distributed computation system used for qualitative system modelling and behaviour simulation of various real life concepts, both discrete and continuous [1]. With FCMs, the emphasis is on identifying causal relations among system elements, which are represented as map concepts. These concepts can correspond directly to an appreciable physical value or they can represent aggregate or even abstract system values. FCMs are also a knowledge modelling technique that, at the same time, represent knowledge and enable the inference of future system behaviour [2]. Hence, the use of FCMs can be roughly divided into two main areas: 1) capturing expert knowledge with a formal system model, and 2) simulating future system behaviour.

Future system behaviour can be inferred by using traditional learning algorithms. However, such algorithms commonly generate results from a bulk of training data, usually as an average result. This approach is unsuitable when data are scarce, infrequent, or occasional, as is often the case in politics, sociology, or psychology. In addition, when training data are hard to collect, the construction of FCMs requires much more effort. There are also issues when there are long temporal gaps between

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