

The Extended Hierarchical Linguistic Model in Fuzzy Cognitive Maps

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Abstract. Fuzzy cognitive maps allow multi-expert causality modelling using linguistic 2-tuples values to improve the accuracy of the computing with words processes regarding classical symbolic approaches. Experts provide causal relations according to their knowledge, because they can have different educational backgrounds, or experiences. It seems logical that they might use different scales to express their mental models. In this work, we propose a new method for extending fuzzy cognitive maps, using the computing with words paradigm and the extended hierarchical linguistic model making it possible to model causal relation by means of linguistic information, where experts would use different linguistic scales to express causal relations. An illustrative example is shown to demonstrate the applicability of the proposed method in the modelling of inter-dependencies among nonfunctional requirements.

Keywords: Fuzzy Cognitive Maps · CWW · ELH · Non-functional requirement

1 Introduction

Recently Fuzzy Cognitive Maps (FCM) have been extended to use linguistic 2-tuples values [1, 2]. The use of the linguistic representation model based on linguistic 2-tuple in FCM allows to perform the Computing with Words(CWW) processes without losing information, improving accuracy regarding classical symbolic approaches [3].

Mental models are cognitive structures which are useful for causal knowledge elicitation and analysis that can be represented by means of FCM [1]. Humans have limitations for representing the world; therefore, mental models are uncompleted representations of reality making it necessary the development of collective mental models.

Modelling causality by means of linguistic information in a multi-expert environment can involve problems defined in multiple linguistic scale contexts. The extended hierarchical linguistic model (ELH) [4] allows different experts to have different uncertainty degrees about causal relations making use of several linguistic term sets with a different granularity of uncertainty.

The aim of this article is to deal with causality modelling problems defined in multi-granular linguistic frameworks using fuzzy cognitive maps. Our proposal consists of a