

## AN EXTENDED SPIKING NEURAL P SYSTEM FOR FUZZY KNOWLEDGE REPRESENTATION

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Received February 2010; revised June 2010

**ABSTRACT.** *In order to extend capability of spiking neural P systems (SN P systems) to represent fuzzy knowledge and further to process fuzzy information, we propose an extended spiking neural P system in this paper, called fuzzy spiking neural P system (FSN P system). In the FSN P system, two types of neurons (fuzzy proposition neuron and fuzzy rule neuron), certain factor and new spiking rule are considered, and content of neuron is fuzzy number instead of natural number (the number of spikes) in SN P systems. Due to graphical nature and advantages of SN P systems, the FSN P system is especially suitable to model fuzzy production rules in a rule-based system. An example is used to illustrate fuzzy reasoning process based on the FSN P system. Due to distributed and parallel computing and dynamical firing characteristics of FSN P system, it can exhibit potential advantages on fuzzy reasoning. In addition, we compare the FSN P system with other methods on fuzzy knowledge representation and fuzzy reasoning.*

**Keywords:** Fuzzy spiking neural P system, Fuzzy number, Fuzzy production rules, Fuzzy reasoning

**1. Introduction.** Membrane computing (or called P systems) belongs to natural computing. Formally, P systems are constructed by the structure and functioning of living cells, as well as from the way cells are organized in tissues, organs and organisms [1, 2, 3]. Hence, there are three main classes of P systems, i.e., cell-like P systems, tissue-like P systems and neural-like P systems. Recently, spiking neural P systems (SN P systems) belonged to neural-like P systems, which were proposed by Ionescu et al. [4], were widely investigated [5, 6, 7, 8]. SN P systems are incorporated into membrane computing from the way that biological neurons communicate through electrical impulses of identical form (spikes). Intuitively, we have a directed graph where the nodes represent the neurons and the edges represent the synaptic connections among the neurons. The flow of information is carried by the action potentials, which are encoded by spikes that are contained in the neurons and can be sent from presynaptic to postsynaptic neurons according to specific rules. SN P systems possess several attractive advantages for practical applications, such