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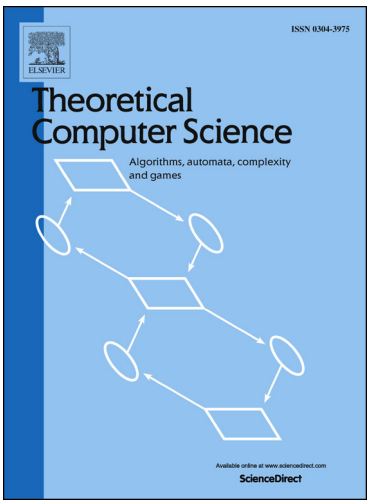

Spiking neural P systems with rules on synapses and anti-spikes

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Spiking neural P systems with rules on synapses and anti-spikes

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Abstract

Spiking neural P systems with anti-spikes (in short, ASN P systems) are a variant of spiking neural P systems (in short, SN P systems), inspired by the way in which neurons process information and communicate to each other through both excitatory and inhibitory impulses. In this work, we consider ASN P systems with rules on synapses, where all neurons contain only spikes or anti-spikes, and the rules are placed on the synapses. The computational power of ASN P systems with rules on synapses is investigated with the restrictions: (1) systems are simple in the sense that each synapse has only one rule; (2) all spiking rules on synapses are bounded; (3) the delay feature and forgetting rules are not used. Specifically, we prove that ASN P systems with pure spiking rules of categories (a, a) and $(a, \bar{a})$ on synapses are universal as number generating and accepting devices. The universality of ASN P systems with spiking rules of categories $(a, \bar{a})$ and $(\bar{a}, a)$ on synapses as generating and accepting devices is obtained, where synapses can change spikes to anti-spikes or change anti-spikes to spikes. We also prove that ASN P systems with inhibitory synapses using spiking rules of category (a, a) on synapses are universal as both generating and accepting devices. These results illustrate that simple form of spiking rules is enough for ASN P systems with rules on synapses to achieve Turing universality.

Keywords: Bio-inspired computing, Spiking neural P system, Turing universality, Anti-spike, Synapse

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