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Editorial: Membrane Computing A Special Issue Dedicated to Gheorghe Păun on his 70^{th} Birthday

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This special issue is dedicated to Academician Gheorghe Păun on the occasion of his 70^{th} birthday anniversary.

This issue contains a selection of papers from the Eighth Asian Conference on Membrane Computing (ACMC 2019), which was successfully held in Xiamen, China, 14-17 November 2019. This conference was organized by the International Membrane Computing Society (IMCS) and Xiamen University.

Membrane computing, initiated by Gheorghe Păun in 1998, is a computational paradigm motivated by the structure and functioning of the living cells. The computational models are called either membrane systems or P systems (from the first letter of Păun). Membrane Computing community has succeeded to achieve during its 22 year old history a set of landmarking successes: the establishment of IMCS, the organization of four regular conference/workshop events, namely ECMC, ACMC, BWMC and CWMC, and the gestation and birth of two periodic publications, Journal of Membrane Computing (JMC) and IMCS Bulletin.

ACMC is one of the flagship conferences on Membrane Computing, aiming to provide a high-level international forum for researchers working in

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membrane computing and related areas, especially for those from the Asia-Pacific region. The seven previous editions had successfully been held in Wuhan (China, 2012), Chengdu (China, 2013), Coimbatore (India, 2014), Anhui (China, 2015), Bangi (Malaysia, 2016), Chengdu (China, 2017) and Auckland (New Zealand, 2018), respectively. Accordingly, special issues were edited in International Journal of Unconventional Computing (Volume 9, Numbers 56, 2013), Romanian Journal of Information Science and Technology (Volume 17, Number 1, 2014), Journal of Computational and Theoretical Nanoscience (Volume 12, Number 7, 2015), Natural Computing (Volume 15, Issue 4, December 2016), Journal of Computational and Theoretical Nanoscience (Volume 13, Number 6, 2016), Romanian Journal of Information Science and Technology (Volume 20, Number 1, 2017), Journal of Optimization (Volume 2017, 2017), Theoretical Computer Science (August 2018), Fundamenta Informaticae (Volume 164, Numbers 2-3, 2019), International Journal of Parallel, Emergent and Distributed Systems (2020) and International Journal of Unconventional Computing (Volumne 15, Number 1-2, 2020).

The nine papers in this issue represents a broad range of topics on membrane computing, covering cell-like, tissue-like and spiking neural P systems and their applications in a variety of fields.

The first paper, by Casauay, *et al.*, designed a genetic algorithm framework to evolve the topology of a spiking neural P system with variable synapses and neurons, and constant rules.

The second paper, by Gou, *et al.*, introduced the routing mechanism in capsule neural network into spiking neural P systems (SNPS) to dynamically update the weights between synapses of spiking neurons. The learning ability of SNPS is realized by the weight update algorithm. This paper made an attempt to construct a novel universal network model of SNPS with learning ability which extracts features though the image convolution. The Mixed National Institute of Standards and Technology database are used to conduct simulation experiments.

The third paper, by Shu, *et al.*, presented a two-stage multi-objective evolutionary algorithm based on classified population to solve vehicle routing problem with time windows, a well-known NP-hard discrete optimization problem with three objectives: the total distance cost, the number of vehicles, and the balance of routes within a limited time. Solomon benchmark instances are used as testing set to make comparisons.

The fourth paper, by Chen, *et al.*, surveyed spiking neural P systems (i.e., neural-like membrane computing models) with learning ability, their architecture, learning mechanism and compare these models, and discussed their advantages and disadvantages and application of these models in solving real-world problems. This paper also discussed the learning mechanism of

associative memory network based on spiking neural P systems with white holes and weights.

The fifth paper, by Dong, *et al.*, proposed an automatic design approach for spiking neural P systems (SN P systems) by using genetic algorithms. A population of SN P systems is created by generating randomly accepted regular expressions. A genetic algorithm is applied to evolve a population of SN P systems toward a successful SN P system with high accuracy and sensitivity for carrying out specific task. An effective fitness function is designed to evaluate each candidate SN P system. Experiments are performed on the automatic design of SN P systems for generating natural numbers and even natural numbers by using the .NET framework.

The sixth paper, by Yu, *et al.*, introduced a deep transfer learning method based on the deep neural network and transfer learning theory to solve the small-sample problem of data in status monitor of electrical appliances. A preprocessing algorithm is proposed to improve the quality of the V-I trajectory image data.

The seventh paper, by Zhang, *et al.*, proposed a bio-inspired learning approach, fault diagnosis method based on learning spiking neural P system with belief AdaBoost, for oil-immersed power transformer. The learning spiking neural P system is used for identifying the fault in the transformer under the framework of ensemble learning.

The eighth paper, by Fan, *et al.*, presented an implementation framework of kernel P systems (kP systems) and its implementation method in CUDA for solving a class of NP-hard problems. Both the framework and the method consider the implementation of the membrane structure, objects and evolution rules of kP systems. The subset sum and satisfiability problems are taken as two examples to show how an implementation that relies in CUDA environment is used for solving NP-hard problems.

The final paper, by Shang *et al.*, discussed the FPGA implementation of numerical P systems (NPS). An extension of NPS, called Generalized Numerical P Systems (GNPS) was introduced and an efficient implementation of GNPS using FPGA hardware was described. This allows to build fast controller chips based on (G)NPS and interacting directly with the environment. Two test cases were presented describing the implementation results of Sobel image edge detection algorithm.

We would like to thank the Editor-in-Chief, professor Andrew Adamatzky, for the opportunity to publish the special issue, the anonymous reviewers for their timely and insightful comments/suggestions to enhance the quality, and the authors contributions.

On behalf of all authors in this special issue, we are indebted to Academician Gheorghe Păun for his creation of membrane computing, friendship, collaboration and scientific generosity and we wish him Happy Birthday!