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Editorial for special issue on the interaction between computation and biology

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The relationship between biology and computing in research has a long and rich history. This special issue of the Natural Computing journal explores various aspects of the interaction between computation and biology, and the benefits to each field this interaction brings.

The roots of this special issue stem from the co-location of two bio-inspired computing events held in York in 2009: the 9th International Conference on Artificial Immune Systems (ICARIS) and the 2nd Workshop on Complex Systems Modelling and Simulation (CoSMoS). The ICARIS conference series provides a platform for exploring a range of immune-inspired computing topics from immune-inspired algorithms and engineering solutions, to the understanding of immunology through modelling and simulation of immune system concepts. The CoSMoS workshops complement ICARIS by providing a forum for research examining all aspects of the modelling and simulation of complex systems and their emergent behaviours. Following these 2009 events a wider call for papers for the special issue was released, attracting further high quality submissions.

A rigorous process of peer review and revision has resulted in the five papers presented in this special issue. As a consequence of the close association with ICARIS 2009 and CoSMoS 2009, the papers all focus on the exploitation of immune system principles for the development of solutions to a variety of complex biological and engineering problems. This common theme highlights how computational systems inspired by biology can support problem solving in both computational and biological domains.

The first paper, "*An immune-inspired approach to qualitative system identification of biological pathways*" by Pang and Coghill, presents work on qualitative model learning (QML), an approach that allows for the construction of a simulation of a system when there is little data available. The authors use an immune-inspired clonal selection algorithm as a search strategy to help construct, or learn, the model of a detoxification pathway of Methylglyoxal. The approach is compared with a more traditional search mechanism typically used in QML, and the paper highlights how the use of a clonal selection approach

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significantly aids the learning process, allowing for an efficient construction of a model of the pathway.

The second paper, "*Grammar-based Immune Programming*" by Bernardino and Barbosa, describes an immune-inspired approach to grammatical evolution (GE) that can be used to evolve a program, in a similar manner to genetic programming. The authors augment a GE approach with a clonal selection algorithm that is used as the search mechanism in place of a more traditional genetic algorithm approach. In addition, the authors propose a novel repair method for the construction of programs during the search and an appropriate grammar on which to perform the search. Their technique is compared with a well known GE approach, GEVA, and results show that the immune-inspired approach is capable of finding simpler programs and requires less computation overhead in terms of repair functions.

The third paper, "*Priming: Making the Reaction to Intrusion or Fault Predictable*" by Drozda et al., develops an immune-inspired approach to misbehavior detection in wireless sensor networks. The authors present a system for misbehavior detection in networks that trades off energy efficiency and misbehavior classification performance. They combine simple ideas from innate and adaptive immunity, and propose a co-stimulation approach that allows for a reduction in the false positives during classification, an important requirement for wireless sensor networks.

The fourth paper, "*A Hybrid Approach for Learning Concept Hierarchy from Malay Text using Artificial Immune Network*" by Nazri et al., presents an approach that uses an artificial immune algorithm to aid the construction of a concept hierarchy in Malay text. The immune algorithm is incorporated into an existing unsupervised approach that uses linguistic patterns to guide the clustering of text. The work compares the original clustering algorithm to the hybridised version with a standard set of parameters for the artificial immune algorithm, and to a set optimised using a particle swarm optimisation algorithm. Three different text data sets are used in the comparison, with the results showing the benefit of the particle swarm optimised set of immune algorithm parameters.

The final paper, "*An Immune System Inspired Clustering and Classification Method to Detect Critical Areas in Electrical Power Networks*" by Wooley et al., explores the use of artificial immune algorithms to monitor and predict failures in electrical power networks. This computationally intensive task requires the ability to learn previously unidentified patterns of behaviour. The paper presents a method for assisting in the identification of critical areas in the network that are prone to voltage stability issues and overloaded lines. Using a number of generic power system networks, the authors use their method to show how artificial immune system approaches compare to an optimised support vector machine algorithm and a *k*-nearest neighbour algorithm.

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