Editorial

Martin Drozda*

Department of Computer Science,
Simulation and Modeling Group,
Leibniz University of Hannover,
Germany
E-mail: drozda@sim.uni-hannover.de
*Corresponding author

Jon Timmis

Department of Computer Science and Department of Electronics,
University of York,
Heslington, UK
E-mail: jtimmis@cs.york.ac.uk

Biographical notes: Martin Drozda is a Research Affiliate at the Leibniz University of Hannover (Simulation and Modelling group). In the past, he was affiliated with the Los Alamos National Laboratory (Basic and Applied Simulation Science group) and the Slovak Academy of Sciences (Institute of Informatics). In 1998, he was a Visiting Scholar at BRICS (Basic Research in Computer Science) at the Aarhus University in Denmark. His current research focus lies within the areas of *ad hoc* wireless networks, artificial immune systems and communications network security. Since 2004 he holds a Dr.rer.nat. degree from the Leibniz University of Hannover.

Jon Timmis is a Professor of Natural Computation and holds a joint appointment with the Department of Computer Science and Department of Electronics. His primary research interest is in the computational abilities of the immune, neural and endocrine systems and how they relate to computer science and engineering. He has published over 90 papers on artificial immune system related research on topics such as theoretical analysis of algorithms, embedded real-time systems, dynamic learning systems, optimisation and the computational modelling of various aspects of the immune system. He chairs the steering committee of the International Conference on Artificial Immune Systems.

Over the years, biology has provided a rich source of inspiration for many different people in many different ways ranging from designing aircraft wings to bulletproof vests. Biology has also been used as a source of inspiration for addressing computation problems such as robotics, data mining, bio-informatics and optimisation. There are many examples of biologically inspired systems such as neural networks, genetic algorithms, genetic programming, swarm intelligence and artificial immune systems. What is of primary interest to the engineer is the extraction of a useful metaphor, or insight, into how to solve a particular problem from a different perspective. Biological systems are complex, and therefore, it is not uncommon to see gross simplifications of the biological

system in order to afford a tractable solution to the problem at hand. Bio-inspired systems are not replicas of their biological counterparts: they are engineered systems that are inspired by them.

With the increasing complexity of wireless networks, the task of network management is becoming more and more difficult to handle. Wireless networks are becoming too complex for even the most skilled system integrators to install, configure and maintain. Therefore, it is desirable that they should be fully autonomic – able to manage themselves following high-level objectives defined by network administrators. This goal implies a need for distributed computational environments that would function with often very limited resources such as bandwidth, energy or processing capability of wireless devices.

Nature has demonstrated itself to be efficient in dealing with many of these limitations, often in a more efficient way than the human-designed counterparts. Therefore, there has been significant interest in applying ideas based on biological systems in the wireless communications domain.

This special issue brings together five papers on diverse topics from the area of bio-inspired wireless networks:

- The contribution by Barrett et al. titled 'From biological and social networks metaphors to coupled bio-social wireless networks' presents an overview of biologically inspired systems with focus on cognitive sensing and control and wireless epidemiology. A cognitively inspired service and model architecture (CosMos) for situational awareness and monitoring of vehicular traffic using a wireless sensor network is discussed. Additionally, EpiNet, a simulator for evaluation of the dynamics of network worm propagation is presented.

- The contribution by Luca Albergante titled 'Automatic management of forums via artificial immune systems' presents a protocol that allows for an automatisation of forum moderation processes. In this paper, Albergante discusses possible ways for developing a self-moderating forum by making use of principles from how immune system cells interact. An architecture is proposed on how this would be implemented on a wireless *ad hoc* network. The proposed system is capable of moderating bad posters in a forum without any human intervention. Simulation results supporting the feasibility of such a solution are shown.

- The contribution by Perrucci et al. titled 'Bio-inspired energy-aware protocol design for cooperative wireless networks' applies bio-inspired cooperation rules to wireless communication networks. A novel communications architecture is proposed. This architecture allows for a communication with the base station as well as for a direct short-range communication among wireless devices. A medium access control protocol particularly designed for peer-to-peer communication among cooperative wireless mobile devices is described.

- The contribution by Boonma and Suzuki titled 'La Niña: an evolutionary noise-aware optimisation framework in self-adaptive publish/subscribe middleware for wireless sensor networks' investigates event publication in TinyDDS, which is a publish/subscribe middleware for wireless sensor networks. A component in TinyDDS, called La Niña, implements a protocol that can self-adapt to dynamic network conditions by reducing the impact of noise on performance evaluation and

by seeking the optimal tradeoffs among performance objectives under given quality of service requirements.

- The contribution by Mutazono et al. titled 'Comparison of robustness of time synchronisation in sensor networks' compares and evaluates a self-organised time synchronisation method and a centralised time synchronisation method. In this work, the authors develop a synchronisation technique in sensor networks based on ideas taken from pulse-couple oscillator (PCO). PCOs can be found in many areas of biology, one good example is that of fireflies who emit a light (or pulse) at times dependent on other flies nearby. Overtime, these may well synchronise, but this is done in a totally distributed manner. The work here develops a time synchronisation technique which is investigated in the context of carrier sense multiple access with collision avoidance (CSMA/CA) protocol. The work finds that the PCO approach affords a greater level of robustness in the system when compared to a reference broadcast synchronisation (RBS) approach.

We would like to thank all the authors for their contributions, and the hard work that have done. We also thank the reviewers for their detailed comments which helped to improve the quality of the special issue.