

Editorial

Evolutionary Algorithms in Health Technologies

Sai Ho Ling ^{1,*}  and Hak Keung Lam ²

¹ School of Biomedical Engineering, University of Technology Sydney, Ultimo, NSW 2007, Australia

² Department of Engineering, King's College London, Strand, London WC2R 2LS, UK;

hak-keung.lam@kcl.ac.uk

* Correspondence: steve.ling@uts.edu.au

Received: 23 September 2019; Accepted: 23 September 2019; Published: 24 September 2019



Abstract: Health technology research brings together complementary interdisciplinary research skills in the development of innovative health technology applications. Recent research indicates that artificial intelligence can help achieve outstanding performance for particular types of health technology applications. An evolutionary algorithm is one of the subfields of artificial intelligence, and is an effective algorithm for global optimization inspired by biological evolution. With the rapidly growing complexity of design issues, methodologies and a higher demand for quality health technology applications, the development of evolutionary computation algorithms for health has become timely and of high relevance. This Special Issue intends to bring together researchers to report the recent findings in evolutionary algorithms in health technology.

Keywords: artificial intelligence; deep learning; evolutionary algorithms; health

1. Introduction

Nowadays, artificial intelligence (AI) plays an important role in medical research, which brings together complementary interdisciplinary research practice, in the development of innovative computer-aided diagnosis systems, medical imaging, home healthcare services, etc. In the last five years, the successful development of many advanced AI technologies in the health market has significantly improved the quality of healthcare. With the rapidly growing complexities of design issues, methodologies and a higher demand for quality health applications, the development of AI becomes timely and highly relevant. This Special Issue intends to bring together researchers to report the recent findings in AI especially evolutionary computation and deep learning in health technologies.

2. Special Issue

In response to the call for papers, we selected six submissions for this Special Issue. All of them are high quality and reviewed by at least two experts in the field of AI and health applications. A summary of the contributions of these six papers is presented below.

Wedyan et al. [1] built a virtual sample generation for deep neural network-based nonlinear modelling with small samples. The main objective of their study was to evaluate the ability of the proposed virtual sample generation to overcome the small sample size problem, which is a feature of the automated detection of a neurodevelopmental disorder, namely autism spectrum disorder. Accounting for concerns in relation to small sample sizes, their technique represents a meaningful step forward in terms of pattern recognition methodology, particularly when it is applied to diagnostic classifications of neurodevelopmental disorders. Besides, the proposed technique has been tested with other available benchmark datasets. The experimental outcomes showed that the accuracy of the classification that used virtual samples was superior to the one that used original training data without virtual samples.

The second paper was written by Haddadene et al. [2]. Different local search-based versions of a non-dominated sorting genetic algorithm were proposed to solve bicriteria vehicle routing problems for Home Healthcare (HHC) services. HHC structures must schedule the visits of caregivers to patients requiring specific medical and paramedical services at home. However, they have potential to lead to high logistics costs and a deteriorated service level if the visits are not planned correctly. Thus, the authors modelled the issue as a vehicle routing problem and considered two objectives to optimize simultaneously. Multi-objective non-dominated sorting genetic algorithms are proposed to solve the vehicle routing problem with time windows, preferences and timing constraints. Metrics such as the distance measure, hyper-volume and the number of non-dominated solutions in the Pareto front were used to assess the quality of the proposed approaches.

Darmawahyuni et al. [3] developed a deep learning-based recurrent neural network to solve electrocardiogram (ECG)-rhythm signal classification problems by using the interpretation of Myocardial Infarction (MI) automatically. ECG signals' morphological view shows significant variation in different patients under different physical conditions. However, traditional machine-learning algorithms have the drawback of using the heuristic features with shallow feature-learning architectures. For this reason, they developed a deep learning approach for learning features automatically, without conventional handcrafted features. They aimed to also study a proper data partitioning ratio for the training and test sets of imbalanced data. They found that the Long Short-Term Memory (LSTM) architecture shows better classification accuracy compared to standard recurrent networks and the Gated Recurrent Unit (GRU).

The fourth paper was written by Pirpinia et al. [4]. Multi-objective class solutions in medical deformable image registration using evolutionary machine learning are proposed. The proposed optimization approach for deformable image registration can provide a set of high-quality trade off solutions. Furthermore, they employed a multi-objective evolutionary algorithm to learn sets of weight combinations for three breast deformable image registration problems. They found that the results are clinically acceptable and concluded that a multi-objective class solution can be machine learned and used to straightforwardly compute multiple high-quality deformable image registration outcomes, potentially leading to more efficient use of deformable image registration in clinical practice.

Miramontes et al. [5] presented how to use the bird swarm algorithm to optimize type-1 and interval type-2 fuzzy systems for the classification of heart rate level. In these systems, the fuzzy rule base is designed based on the knowledge of experts, and the membership functions are optimized by the bird swarm algorithm to improve the classification rate and provide a more accurate diagnosis. Based on the simulation results, they concluded that the fuzzy systems with Gaussian membership functions provide a better classification accuracy than those designed with trapezoidal membership functions. Additionally, tests were performed with the Crow Search Algorithm to carry out a performance comparison with the Bird Swarm Algorithm, the latter being the one with the best results.

The last paper is a review paper authored by Khan et al [6]. This comprehensive review addresses how artificial intelligence, especially evolutionary computation, is employed to solve electrical impedance tomography (EIT) problems. EIT is a new imaging method. By injecting a small amount of current, the electrical properties of tissues are determined and measurements of the resulting voltages are taken. By using a reconstructing algorithm, these voltages are then transformed into a tomographic image. In addition, they reviewed a number of clinical applications using EIT.

Acknowledgments: Thanks are given to the editorial staff of *Algorithms*, the anonymous reviewers for their support, and to the authors for their contributions to this Special Issue.

Conflicts of Interest: The authors declare no conflict of interest.

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