EDITORIAL

Applications of Computational Intelligence based Systems for Societal Enhancement

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1 | INTRODUCTION

Computational Intelligence (CI), originally represented by the three subjects of Evolutionary Computation (EC), Fuzzy Logic (FL) and Neural Networks (NNs), has significantly evolved to date and is ever more embedded in both software platforms and hardware devices forming intelligent systems capable of self-adaptation, decision-making and problem-solving. With a quick inspection of the scientific literature in Computer Science, one can indeed notice a significant expansion in the range of available CI tools, with e.g. modern EC optimisers making use of surrogate models (which can be based on NNs), or being used to evolve both topology and hyperparameters of neural systems. The latter systems have also grown significantly and currently offer numerous kinds of networks from e.g. recurrent, through convolutional to Generative/Adversarial deep NNs.

These highly interconnected and high-level algorithms are becoming ubiquitous as their applicability has widened and grown to traverse many disciplines and application domains. In the past, the technological fields that benefited the most from applying CI techniques were in engineering, such as system control and design, robotics, telecommunication, etc. However, the application scope of modern CI methods has widened significantly, thus making it possible to analyse large data sets, manipulate images and videos, extract sentiment and relevant information from plain text and audio recordings. Hence, modern CI turns out to be helpful in many areas which strongly impact our society, such as e.g. medicine, finance, education, intelligent transportation, sustainability, etc., where it is key to analyse available data, optimise processes and provide systems with extra capabilities.

If placed in the right context, CI has then the potential of generating societal impact beyond enabling technological advancement per se. It can now support the deployment of technology to optimise not only the financial viability but as well the usability and benefit to the public. State of the art optimisation has become focused on sustainability and

waste rather than profit or cost reduction; now optimisation is critical to address the compromise between protecting society and the economic activities of small stockholders, and not just the large scale businesses.

In this light, this special issue has gathered recent advances on CI addressing relevant research questions leading to societal impact and calling for the design of more intelligent systems enhancing our society in the future.

2 | AREAS OF MAJOR IMPACT FROM THIS SPECIAL ISSUE

The contributions selected for this special issue display high humanitarian, environmental and economic impact on several themes that can be grouped, for convenience, in the three main categories indicated below.

2.1 | Sustainable processes

There are various application domains of life where CI can make the difference in terms of sustainability.

In nowadays life, for example, electric vehicles are becoming ubiquitous, thus posing the problem of deploying their charging station in many cities. The study in [1] addresses this problem through evolutionary-based approach to achieve optimality.

A hybrid fuzzy-system is instead designed in [2], in the context of analysing sustainable operational issues of ash handling units for achieving a more ecofriendly production in coal-fired power industry.

2.2 | Living through pandemics

The research community in CI has promptly reacted to many challenges originated from the spread of the SARS-CoV-2 virus, better known as Covid-19, since December 2019. Intelligent solutions have been proposed to provide remote services, mitigate and contain pandemics, which can also help to address other future challenges arising from natural disasters.

The work in [3] proposes an original analytical model, based on Self Organising Maps, allowing governments and organisations for easy decision making on containment strategies combining lockdowns and protective cordons. Once applied on publicly available data from across Great Britain (GB), prediction results indicated a reduction of the peak infection rate while making up to 25% of GB constituencies be able to continue 'business as usual' inside the proposed protective cordons.

In this line, the Delphi-based multicriteria decision-making system proposed in [4] is an useful service allowing for finding the most appropriate location of an isolation hospital. The decision is based on a high number of relevant factors which would be difficult to simultaneously take into consider otherwise.

2.2.1 | Social and economical welfare

This group covers a wide range of application domains, including education, health, economy, social trust and consensus.

The work done in [5] shows how temporal concept analysis can be used to design a model allowing for the identification of students at risk of dropping out of their studies in massive online open courses, which are becoming more and more popular worldwide.

Moving from education to health & care, the data mining approaches in [6] are applied to genomic data from six

types of cancer, namely breast, colon, lung, thyroid, prostate and kidney, to achieve highly interpretable knowledge without requiring hypothesis or previous knowledge which can be prone to bias the model. The intelligent system proposed in [7] makes use of fuzzy logic to obtain a recommendation system assessing and raking hospitals based on their services quality and users feedback.

CI techniques also play a key role in measuring diversity, spread, inequality and other relevant indicators for several sectors, including health and economics. In [8], optimal measures of economical welfare and species diversity are obtained by solving a linear programming problem formulated as the Choquet integral of defined 'buoyant' and 'anti-buoyant' fuzzy measures. Social trust is another worth-considering indicator for implementing meaningful recommendation or decision-making systems. A 'similarity–trust' clustering approach to social network analysis is proposed [9], which allows for the solution of consensus group decision-making problems. Similarly, in [10], a 'social-trust-aware' operator is proposed for improving social recommender systems, and a measure of consensus is used in [11] to indicate the degree of agreement among the articles written in the same period for comparing the global news sentiment. The latter study is a clear example of applied sentiment analysis, showing how to use CI to better inform policymakers about public opinion.

Finally, modern cybersecurity approaches are increasingly relying to CI to prevent malware from disrupting services [12].

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