Guest Editorial

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Model Complexity, Regularization, and Sparsity

Over the past few years, sparsity has become one of the most widely used and successful forms of regularization for learning adaptive representations for descriptive and discriminative tasks.

Important problems in computational intelligence are often ill-posed, in the sense that the available data are insufficient to determine a unique solution. Regularization techniques have been widely adopted to address these problems, adding to the problem formulation additional criteria that are based on prior knowledge regarding the expected solution. When the problem is expressed as a functional to be minimized, regularization consists of the introduction of one or more penalty terms, designed to penalize solutions that deviate from the priors. A common choice of prior is that the solution belongs to a family of models of restricted complexity.

One of the most prominent and successful forms of regularization is based on the *sparsity* prior, which promotes solutions that can be expressed as a linear combination of only a few atoms belonging to a *dictionary*. Sparsity has become one of the leading approaches for learning adaptive representations for both descriptive and discriminative tasks, and has been shown to be particularly effective when dealing with structured, complex and high-dimensional data, in numerous fields including statistics, signal processing and computational intelligence. Not surprisingly, these aspects have recently gained considerable attention in the computational intelligence community, and the number of publications in CIS journals and conferences referring to "Sparse" or "Sparsity" has increased exponentially over the past few years.

This special issue presents recent advances in computational intelligence regarding techniques for controlling model complexity and regularizing ill-posed problems. We received 17 paper submissions in response to our call for papers. After a rigorous peer review process, the following three papers have been accepted for publication in the special issue.

The first paper, *"Learning Distributional Parameters for Adaptive Bayesian Sparse Signal Recovery"* by Ritwik Giri and Bhaskar Rao, addresses the sparse coding problem in a Bayesian framework, where sparse representations are computed by selecting an appropriate prior distribution for the representation coefficients. The authors propose a generalized scale mixture family as a prior distribution, showing that this choice leads to the unification of many popular approaches in the literature. The authors also present an adaptive signal recovery framework, where the parameters of these sparsity-promoting distributions are learned from signals during iterations. Extensive experiments show the efficacy of this adaptive approach over other Bayesian sparse recovery algorithms.

The second paper, *"Regularized Multivariate Analysis Framework for Interpretable High-Dimensional Variable Selection"* by Sergio Muñoz-Romero, Vanessa Gómez-Verdejo, and Jerónimo Arenas-García, proposes a feature-extraction framework that promotes sparsity to gain interpretability of the extracted features. In particular, the authors consider a multivariate analysis framework that includes a penalty term based on a sparsity-inducing norm, which is shown to guarantee interpretability of the extracted features. The authors propose an efficient algorithm to solve the regularized problem that, compared to existing solutions in the literature, reduces the memory requirements and improves classification performance. These benefits are demonstrated in a remote sensing application and two high-dimensional face recognition and genomic datasets.

The third paper, *"Super-sparse Learning in Similarity Spaces"* by Ambra Demontis, Marco Melis, Battista Biggio, Giorgio Fumera, and Fabio Roli, considers a large class of algorithms that operate on input samples represented in terms of similarities against a

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set of predefined reference prototypes. During operation, these algorithms can become severely computationally demanding as they have to compute the similarity of each input sample against all the prototypes. The authors present a novel method to effectively reduce the number of reference prototypes and dramatically decrease the computational complexity and memory requirements of these algorithms. In particular, the authors propose an algorithm to jointly address the learning and the prototype-selection problems, and show that this provides a very compact set of virtual prototypes. Experiments in face verification and age-estimation applications show that the learned set of virtual prototypes guarantees a reduction of up to ten times the complexity for Support Vector Machines, LASSO, and ridge regression, without any substantial performance degradation.

We take this opportunity to thank all of the authors for their contributions, and the anonymous reviewers for their thorough reviews and constructive comments. We are also grateful to the Editor in Chief, Prof. Hisao Ishibuchi, for his strong support and invaluable assistance in handling this special issue.

President's Message

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This equation reads as follows: The sum of neural networks, fuzzy systems, and evolutionary computation is less than the whole of CI, since there are new topics that are in the CI sphere, such as data science, smart Xs, cyber-physical systems, autonomous systems, and even machine learning. And CI, of course, is not everything.

A natural vehicle for outreach research communities working on new topics is the IEEE Transactions on Emerging Topics in Computational Intelligence (TETCI), whose founding Editor-in-Chief, Dr. Yew-Soon Ong, is a professor at Nanyang Technological University, in Singapore. The first issue of TETCI is expected to appear in February, 2017. Submissions are already being welcomed. I encourage you to submit your best papers on emergent topics in CI to TETCI.

Pablo A. Estevez

Call for Papers for Journal Special Issues

Special Issue on "AI-based and AI-assisted Game Design"

Journal: ***IEEE Transactions on Computational Intelligence and AI in Games***
Guest Editors: Antonios Liapis, Georgios N. Yannakakis, Michael Cook, and Simon Colton
Submission Deadline: January 16, 2017
Further Information: Graham Kendall (Graham.Kendall@nottingham.edu.my)
http://www.graham-kendall.com/TCIAIG/wp-content/uploads/2016/07/AIGD.pdf

Special Issue on "Computational Intelligence in Aerospace Science and Engineering"

Journal: ***IEEE Computational Intelligence Magazine***
Guest Editors: Massimiliano Vasile, Chit Hong Yam, Edmondo Minisci, and Ke Tang
Submission Deadline: January 31, 2017 (Publication: November 2017)
Further Information: Massimiliano Vasile (massimiliano.vasile@strath.ac.uk)

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