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Cognitive Modelling and Learning for Multimedia Mining and Understanding

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Cognitive modelling and learning have become a new trend for advanced signal analysis, especially for semantic content extraction and understanding. Various approaches have been proposed in recent years to address a range of underlying challenges, including data acquisition, denoising, feature extraction, dimensionality reduction, restoration, data compression, segmentation, detection and classification [1, 2]. In addition, fusion and big data mining is also receiving growing attention for enhanced modelling and analysis.

With rapid developments in machine learning, signal processing and big data analysis techniques, in particular compressed sensing, deep learning and multi-kernel based modelling, there are exciting new opportunities for exploiting these advances for semantic signal analysis and understanding in a range of inter-disciplinary research areas. Relevant applications can currently be found in fields ranging from communications, energy and manufacturing to health, security, remote sensing and numerous other fields. As a result, it is timely to summarise recent progress and advancements, including new models, algorithms and innovative applications, particularly those that are focussed on scalability, quality, efficiency and efficacy of solutions.

In light of this, this special issue aims to solicit state-of-the-art contributions and also provide a premier forum for both academic and industrial research community to report progress, exchange findings and facilitate multidisciplinary research works. The focus of the special issue covers not only fundamental models, algorithms, integrated solutions and novel applications but also benchmark data and methods for performance assessment.

In this special issue, in total, nine papers are included selected from over thirty submissions. Although the topics of these papers are quite diverse, we have found a strong trend of the continuous blooming in deep learning–based cognitive modelling and learning, along with hybrid approaches and a wide range of applications. These can be briefly summarised as follows:

Deep Learning–Based Cognitive Modelling and Learning

Yang et al. proposed a novel deep density model, namely the Deep Mixtures of Factor Analyzers with Common Loadings (DMCFA), in which an efficient greedy layerwise unsupervised learning is utilized with a mixture of factor analysers sharing common component loadings in each layer to reduce significantly both the number of free parameters and computation complexity [3]. Ye et al. proposed Deep Attention Unit Generative Adversarial Networks (DAU-GAN) model for unsupervised object transfiguration, where the GAN-based deep learning network is applied to specific regions selected by the attention model for more effective image-to-image translation [4]. Ding et al. proposed the Reference-based Long Short Term Memory (R-LSTM) model within the encoder–decoder framework, which has been successfully applied to generate a more descriptive sentence for the given image by introducing reference information [5].

Hybrid Bio-inspired Approaches

Li et al. proposed a bio-inspired CSA-DE/EDA approach, where the clonal selection algorithm is combined with the differential evolution (DE) algorithm and the estimation of

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distribution algorithm (EDA) for the segmentation of brain magnetic resonance (MR) images [6]. As an extension to the manifold regularized semi-supervised learning, Ma et al. proposed an ensemble p-Laplacian regularization (EpLapR) approach to fully approximate the intrinsic manifold of the data distribution, in which a fused graph is formed for scene image recognition [7]. Du and Hu [8] proposed the Simultaneous Discriminative Feature and Adaptive Weight Learning (SDFAWL) framework, where group sparse representation with adaptive feature weighting is employed to optimize the objective function for effective face recognition with occlusion and illumination changes.

Cognitive Modelling–Based Applications

Gao et al. [9] proposed a deep learning algorithm combining Deep Convolutional Neural Network (DCNN) trained with an improved cost function and support vector machine (SVM), which explicitly facilitates intra-class compactness and inter-class separability in the learning process for improved target recognition in synthetic aperture radar images. Sun et al. [10] have innovatively applied the biclustering model to analyse the trading patterns of stock market, followed by the K-nearest neighbour (KNN) algorithm to transform the trading rules to the corresponding trading actions for prediction of the stock investment styles. Cai and Shao [11] introduced a Convolutional Neural Networks (CNNs)–based local multi-modal feature learning framework (LM-CNN) for RGB-D scene classification, which can effectively capture much of the local structure and automatically learn a fusion strategy for object-level recognition instead of simply training a classifier on top of features extracted from both modalities.

In summary, this special issue has addressed several key challenges within relevant topics. Herein we greatly thank the particular contributions from all authors, anonymous reviewers and the management and Editorial team of the Cognitive Computation Journal.

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