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EDITORIAL

Special issue on intelligent control and information processing

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Research on intelligent control and information processing is becoming year by year more and more relevant for the impact on theory and applications. Intelligence and cognition mechanisms represent the frontier in information processing and control and the direction where young researchers are invited to take part. The 2013 International Conference on Intelligent Control and Information Processing (ICICIP 2013) held on June 9–11, 2013, in Beijing, China moved in this direction, with the idea to gather researcher investigating those fields. We are grateful to Soft Computing for having given us the opportunity to organize the special issue on Intelligent Control and Information Processing.

ICICIP 2013 received 432 submissions from more than 30 countries and regions. Based on a rigorous review process, 167 papers were selected for publication in the proceedings. Among them, some papers were selected, whose authors were asked for a significant content extension and entered the due review process for the special issue. We are very grateful to the reviewers for their hard work, which yielded 12 accepted papers you will find in this special issue.

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Selected papers cover a view of the frontier of research in intelligent control and information processing. Addressed topics cover the basic theory behind change-point methods and their use, Cohen–Grossberg neural networks, the passivity of delayed neural networks aspect, the dynamic behavior of coupled two-component Camassa–Holm dynamic system, type-2 fuzzy systems and adaptive/approximate dynamic programming. In addition to theoretical aspects also application papers are herein included covering relevant topics on smart grids, smart building, intelligent vehicles, hypersonic flight vehicles, maze navigation, to name a few.

In summary, the contributions of this special issue can be roughly classified into three major categories: machine learning methods, type-2 fuzzy systems and adaptive/approximate dynamic programming methods.

The first category consists of six papers.

Alippi, Boracchi and Roveri present the ensemble of change-point methods (CPMs) idea. CPMs are statistical tests designed to assess whether a given data sequence contains a change in stationarity associated with an abrupt change in the data-generating process or not. Shall that be the case, CPMs also provide an estimate of the change point location. The use of ensembles improves the quality of the change-point estimate when residuals inspected for the change are not i.i.d., as it is often the case in real world scenarios.

Squartini and Piazza propose a hybrid soft computing algorithmic framework, where genetic, neural networks and deterministic optimization algorithms jointly operate, to perform an efficient scheduling of the electrical tasks and the activity of energy resources, by adequately handling the inherent nonlinear aspects of the energy management model. In particular, in order to address the end-user comfort constraints, the home thermal characterization is needed: this is accomplished by a nonlinear modeling relating the energy

demand with the required temperature profile. A genetic algorithm, based on such model, is then used to optimally allocate the energy request so as to match the user thermal constraints, and therefore allow the optimization algorithm to identify the remaining energy management actions. From this perspective, the ability to schedule the tasks and allocate the overall energy resources over a finite time horizon is assessed by means of diverse computer simulations in realistic conditions, allowing the authors to positively conclude about the effectiveness of the approach.

Wang and Song investigate the dynamic behavior of the modified coupled two-component Camassa–Holm dynamic system arisen from shallow water wave movements. The original system is converted into a Lagrangian semilinear one in which the associated energy becomes an additional variable facilitating the study of the behavior of wave breaking. It is concluded that solutions of the system continue as global dissipative solutions after wave breaking, which presents an interesting and useful result for better understanding the inevitable phenomenon before and after wave breaking.

Zhang, Li, Guo, et al. propose a class of neural dynamics to solve online time-varying problems. Different models based on different functions are investigated for solving the time-varying inverse square root problem. Different gradient type (G-type) models based on different energy functions have been investigated and suitably compared. The convergence of proposed models is investigated.

Xiao, Zeng and Shen integrate the passivity of uncertain delayed neural networks, which is described in the form of differential equations with discontinuous activation. The activation functions are unbounded. Based on differential inclusion and a nonsmooth analysis theory, the generalized Lyapunov approach has been employed and led to a passivity criterion of discontinuous neural networks. Sufficient conditions are established in the form of LMI which can be conveniently verified through the MATLAB LMI Toolbox.

Shan, Zhang, Yang and Wang study the stability issue of a class of Cohen–Grossberg neural networks characterized by multiple mixed delays. Based on a generalized convex combination inequality a new delay dependent stability criterion for Cohen–Grossberg neural networks with multiple interval time-varying delays and distributed delay is attained. The problem can be naturally solved with MATLAB LMI Toolbox.

The following three papers relate to the type-2 fuzzy systems.

Yang, Yuan, Yi, et al. designed a direct adaptive interval type-2 fuzzy neural network (IT2-FNN) controller for hypersonic flight vehicle (GHFV). Interval type-2 fuzzy sets (IT2-FSs) with Gaussian membership functions are used in antecedent and consequent parts of fuzzy rules. The IT2-FNN directly outputs elevator deflection and throttle setting which make the GHFV track the altitude command signal and meanwhile maintain its velocity. The tracking errors on velocity and altitude are used as inputs of IT2-FNN. Simulation results validate the effectiveness and robustness of the proposed controller especially under large uncertainties.

Ha, Yang, and Wang provide a method combining classical support vector machines with type-2 fuzzy system. It is usually hard to deal with classification problems based on type-2 fuzzy samples established on non-probability space. The non-negativeness of the decision variables of general fuzzy optimization problems is too strict to be satisfied in some practical applications. Motivated by this, the concept of expected fuzzy possibility measure is proposed. Results show the effectiveness of the designed type-2 fuzzy support vector machine on the expected fuzzy possibility space.

Li, Zhang, Wang and Yi present a type-2 fuzzy method-based data-driven strategy for modeling and optimization of thermal comfort and energy consumption. A methodology to convert the interval survey data on thermal comfort words to the interval type-2 fuzzy sets (IT2 FSs) is proposed that reflects the inter-personal and intra-personal uncertainties. This data-driven strategy includes three steps: survey data collection and preprocessing, ambiguity-preserved conversion of the survey intervals to their representative type-1 fuzzy sets (T1 FSs), and IT2 FS modeling. Then, using the IT2 FS models of thermal comfort words as antecedent parts, an evolving type-2 fuzzy model is constructed to reflect the online observed energy consumption data. Finally, a multi-objective optimization model is presented to recommend a reasonable temperature range that can give comfortable feeling while reducing energy consumption. The proposed method can be used to realize comfortable but energy-saving environment in smart home or intelligent buildings.

The papers in the last category belong to the area of adaptive/approximate dynamic programming methods.

Zhao, Wang and Liu propose a novel supervised actor-critic (SAC) approach for adaptive cruise control (ACC) problem. The key elements required by the SAC algorithm, namely actor and critic, are approximated by feedforward neural networks. The output of the actor and the state are input to critic to approximate the performance index function. A Lyapunov stability analysis approach has been presented to prove the uniform ultimate boundedness property of the estimation errors of the neural networks. Moreover, author use the supervisor controller to pre-train actor to achieve a basic control policy, which can improve the training convergence and success rate. Experimental results in several driving scenarios demonstrate that the SAC algorithm performs well, so it is feasible and effective for the ACC problem.

Ni and He analyze an internal goal structure based on heuristic dynamic programming, named GrHDP, to tackle the 2-D maze navigation problem. Classical reinforcement learning approaches have been introduced to solve this problem

in literature, yet no intermediate reward has been assigned before reaching the final goal. In this paper, authors integrated one additional network, namely, the goal network, into the traditional heuristic dynamic programming (HDP) design to provide the internal reward/goal representation.

Song, Xiao and Wei propose a novel multi-objective adaptive dynamic programming (ADP) method to obtain the optimal controller of a class of nonlinear time-delay systems. By using the weighted sum approach, the original multi-objective optimal control problem is transformed to the single problem. An ADP method is established for nonlineartime-delay systems to solve the optimal control problem. To demonstrate that the presented iterative performance index function sequence is convergent and the closed-loop system is asymptotically stable, the convergence analysis is also given.

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