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EDITORIAL

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Some research works in the State Key Laboratory of Intelligent Technology and Systems

This special issue is organized to introduce the research works that have being conducted in the State Key Laboratory of Intelligent Technology and Systems (LITS), a state key lab located in Tsinghua University. However, due to space limit, our introduction is certainly not exhaustive. We will use a few sample papers from various research groups to organize this issue.

To start with, we first briefly introduce the history of the State Key Laboratory of Intelligent Technology and Systems. The LITS state key lab was started to build in 1987 and officially launched in 1990 after successfully passing the evaluation of the government. Because of the outstanding performance, the LITS lab has received numerous national awards since her birth, which have made her single out from other counterpart state key laboratories in the national range. For instance, the LITS lab was awarded as "Excellent State Key Lab" for three consecutive times, and the LITS lab won the "Gold Cattle" Prize on the meeting for celebrating the 10th Anniversary of the State Key Lab Development in the October of 1994. The current director is Prof. Xiaoyan ZHU.

The laboratory is mainly engaged in basic research on the principles and methods of artificial intelligence, including intelligent information processing, statistical machine learning, intelligent control and artificial neural network theories, and the research on various applications relating to artificial intelligence, such as intelligent robots, natural language processing, image processing, multi-media data analysis, information retrieval, text mining, etc. This special issue consists of eight papers covering some of these research directions. In the following presentation, we briefly summarize these papers in turn.

The first paper on an extended SHESN with leaky integrator neuron and inhibitory connection for Mackey-Glass prediction is from the neural and cognitive science research group led by Prof. Zhidong DENG, whose research interests are mainly on inter-connections between intelligent control and cognitive science. The first author, Bo YANG, is currently pursuing his Ph.D. degree on computational neuroscience in Prof. DENG's group. This paper presents a novel extension of the state reservoir of SHESN, a well-known network having remarkable capabilities of approximating dynamics for complex systems, using leaky integrator neurons and inhibitory connections, and the authors apply the new method to the Mackey-Glass prediction problem with improved robustness and prediction capabilities.

The second paper on sparse representation-based approaches for video copy detection is from the intelligent multimedia research group led by Prof. Bo ZHANG, a member of Chinese Academy of Sciences and an Honorary Doctor of Natural Sciences of Hamburg University. The first author is Prof. Jianmin LI, who has conducted systematic studies on intelligent video and image data analysis. His research ranges from machine learning methods to applied problem solving. The second author, Chen SUN, is now a Ph.D. student in University of Southern California. In this

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paper, the authors present a technique to detect nearly duplicate copies of videos from imperfect reference databases. To alleviate the limitations of existing methods on the assumptions that the reference database contains the original videos, the authors present a robust sparse representation-based method by using the sparsity-inducing 1-norm regularizor to penalize a reconstruction error objective.

The third paper on distributed support vector machines in small-scale strongly connected networks is from the research team led by Prof. Hua XU, who has conducted extensive research works on intelligent information processing, robot control, parallel computing, etc. The other two authors, Yun WEN and Jixiong WANG, are doing their thesis work in Prof. XU's group. Rather than exchanging information only among intermediate neighboring sites, this paper presents a novel deterministic protocol-based network communication policy to significantly reduce the total number of iterations and thus speed up the convergence of a distributed learning algorithm for support vector machines. The outperformance is empirically evidenced by real experiments on several benchmark datasets.

The fourth paper on action recognition from arbitrary views using 3D-key-pose set is from the image processing research group led by Prof. Xiaoqing DING, a fellow of International Association of Pattern Recognition and a recipient of the second-class National Scientific and Technological Progress Award. The first author, Junxia GU, got her Ph.D. degree in 2010 from the same group. The last author, Shenjing WANG, is currently a full professor and the director of the Research Institute of Image and Graphics. To address the difficult problem of recovering 3D human pose sequence from arbitrary view, this paper presents an approach to model pose properties as well as complementary dynamic features, with an automatically constructed 3D-key-pose set. A fusion scheme is applied at the decision stage to combine the outputs of multiple action models.

The fifth paper on graph-based methods for keyword extraction is from the natural language processing research group led by Prof. Maosong SUN, the former head of the Department of Computer Science and Technology, Tsinghua University. The first author, Zhiyuan LIU, is a post-doctorial fellow in the same group. To address the problem of current graph-based methods that rely solely on the topological structures, this paper presents a new method to incorporate various prior knowledge into a graph-based method for improve the performance of keyword extraction from complex text documents. The prior knowledge can be frequency-based, position-based, or even semantic-based. Significant empirical improvements were observed by the authors in their real-world experiments.

The sixth paper on analyzing user behavior on search engines is coauthored by three students from the information retrieval research group led by Prof. Shaoping MA, who is the former director of the State Key Laboratory of Intelligent Technology and Systems. The first author, Ke XIE, is from Beihang University and he finished this work during his internship in Tsinghua University. The second author, Huijia YU, is a master student, and the third author, Rongwei CEN, is a Ph.D. student, both from Prof. MA's group. For the important research topic of user behavior analysis, this paper performs systematic studies on the various aspects of users' searching behavior, including query length, ratio of query refining, recommendation access, etc. One important discovery of the analyses is that different information needs often lead to different behaviors.

The seventh paper on wireless multicarrier digital transmission via frames is from the signal processing research group led by Prof. Xianda ZHANG, a professor of Education Ministry Cheung Kong Scholar and a Specially Appointed Professor in the Key Lab for Radar Signal Processing, Xidian University. The first author, Fangming HAN, is an assistant professor from the same group. This paper presents a new digital signal transmission scheme that employs over-complete frames as modulation pulses. One important feature of the new scheme is that it can achieve a signaling rate higher than the Nyquist rate, and for the additive white Gaussian noise (AWGN) channels, the proposed scheme can achieve the Shannon capacity asymptotically.

The last paper on gradually approximating the maximal terminal state region in model predictive control (MPC) is from the intelligent control research group led by Prof. Fuchun SUN, one of Chinese NSF distinguished Young Scholars and an associate editor of IEEE Transactions on Neural Networks. Prof. SUN has received numerical awards for his outstanding contributions to the fields of intelligent control, including the 18th Choon-Gang Academic Awards by Korea. Prof. Huaping LIU and the other two authors, Yafeng WANG and Dongfang YANG, are all from the same research group. The main contribution of this paper is to propose a novel approach of gradually approximating the maximal terminal state region in MPC, with a theoretical guarantee on the convergence to the maximal terminal region when the number of iterations goes to infinity.

As we have stated, the above eight papers only cover a small sample of the research works that have being conducted in the State Key Laboratory of Intelligent Technology and Systems. Other exciting research directions that we have no space to introduce in this special issue include intelligent structure learning for complex data understanding, deep semantic understanding of Web-scale unstructured image/text data, the interdisciplinary research on the interface between machine learning and cognitive science, etc. Finally, we would express our sincere thanks to all the authors of the eight papers for their valuable contributions, and we would also like to deeply

thank all the faculties, students, and staffs who have worked in the LITS state key lab. Without them, nothing will be possible!

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