Social Manufacturing: A Paradigm Shift for Smart Prosumers in the Era of Societies 5.0

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WELCOME to the fifth issue of the IEEE TRANSACTIONS ON COMPUTATIONAL SOCIAL SYSTEMS (TCSS) this year. Seventeen regular articles and a brief discussion on social manufacturing (SM) are presented here. In addition, a special issue on "Human-Centric Cyber Social Computing" is included. We would like to take the opportunity to thank the Guest Editors for their time and effort devoted to the special issue.

Scanning the Issue

1. Computational Rumor Detection Without Nonrumor: A One-Class Classification Approach

Amir Ebrahimi Fard, Majid Mohammadi, Yang Chen, and Bartel Van de Walle

This article tackles the identification of rumors via a novel classification approach called one-class classification (OCC). In this approach, the classifier is trained with only rumors, which means that the nonrumor data points are not needed at all. For this study, the authors use two primary Twitter data sets in this field and extract 86 features from each tweet. They, then, apply seven one-class classifiers from three different paradigms and compare their performance. The results show that this approach can recognize rumors with a high level of F1-score. This approach may influence the predominant mentality of scholars about computational rumor detection and puts forward a new research path toward dealing with this problem.

2. Optimal Auction Design With Quantized Bids for Target Tracking via Crowdsensing

Nianxia Cao, Swastik Brahma, Baocheng Geng, and Pramod K. Varshney

This article considers the design of an auction mechanism for target tracking via crowdsensing. The formulated crowdsourcing framework consists of a set of sensors and a fusion center (FC). The developed auction mechanism addresses participatory concerns of the sensors that arise due to energy consumption associated with sensor participation while maximizing the utility of the FC to achieve desired sensing objectives and preventing market manipulations. Moreover, since a crowdsensing environment is typically resource-constrained, the authors consider that the sensors in the network quantize their private value estimates regarding their energy costs prior to communicating them to the FC. Furthermore, this article also proposes the concept of selecting a subset of sensors (bidders) to bid (from a set of available sensors) to satisfy resource constraints during the bidding process. Extensive numerical results are provided to gain insights into the proposed mechanism.

3. Analysis of Adapted Films and Stories Based on Social Network

Tapan Chowdhury, Samya Muhuri, Susanta Chakraborty, and Sabitri Nanda Chakraborty

This article proposes an efficient graph mining method to detect the deviation of the relationship among the characters in adapted films from the original story. They analyze two distinguished novels, Nastanirh and Harry Potter and the Philosopher's Stone, and their celebrated film versions as the case study to indicate how the successful filmmakers interpret the characters in their visual version. The difference in the distribution of the characters in each chapter and the corresponding scene is also analyzed to manifest the convergences and divergences between the two art of expressions. Their approach is distinctive, and the analytical results are satisfactory and unbiased than the human perspective.

4. Decentralized Autonomous Organizations: Concept, Model, and Applications

Shuai Wang, Wenwen Ding, Juanjuan Li, Yong Yuan, Liwei Ouyang, and Fei-Yue Wang

This article presents a systematic introduction of Decentralized Autonomous Organizations (DAO), including its concept and characteristics, research framework, typical implementations, challenges, and future trends. Specially, a novel reference model for DAO, which employs a five-layer architecture (i.e., basic technology layer, governance operation layer, incentive mechanism layer, organization form layer, and manifestation layer), is proposed. This article is aimed at providing helpful guidance and reference for future research efforts.

5. Providing Appropriate Social Support to Prevention of Depression for Highly Anxious Sufferers

Fei Hao, Guangyao Pang, Yulei Wu, Zhongling Pi, Lirong Xia, and Geyong Min

This article aims to provide appropriate social support (SS) to prevent depression in highly anxious undergraduates. A self-rating anxiety scale, a self-rating depression scale, and an SS scale for anxiety and depression are conducted from 1425 undergraduates from 18 universities in China via a cluster random sampling method. Based on the collected questionnaire data, this article first reveals that the distribution of anxiety data and depression data follows a Gaussian distribution. Then, using a Gaussian mixture model, these data are clustered in terms of anxiety index and depression index.

Digital Object Identifier 10.1109/TCSS.2019.2940155

Based on the observations extracted from the clusters, the correlation between anxiety, depression, and SS is studied by correlation analysis. Finally, through the hierarchical multiple regression analysis, the corresponding moderating effect of SS between anxiety and depression is figured out. Detailed analysis indicates that high-level SS, such as the help and support from a personal friend or family member, could reduce the risk for depression in highly anxious undergraduates.

6. Multi-Modality Behavioral Influence Analysis for Personalized Recommendations in Health Social Media Environment
Xiaokang Zhou, Wei Liang, Kevin I-Kai Wang, and Shohei Shimizu

Recently, health social media have attracted more and more people to share their personal feelings, opinions, and experience in the context of health informatics, which has drawn increasing attention from both academia and industry. This work focuses on behavioral impact analysis based on heterogeneous health data generated in social media environments. An integrated deep neural network (DNN)-based learning model is designed to analyze and describe the latent behavioral influence hidden across multiple modalities, in which a convolutional neural network (CNN)-based framework is used to extract the time-series features within a certain social context. The learned features based on cross-modality influence analysis are then trained in a SoftMax classifier, which can result in a restructured representation of high-level features for online physician rating and classification in a data-driven way. Finally, two algorithms within two representative application scenarios are developed to provide patients with personalized recommendations in health social media environments. Experiments using real-world data demonstrate the effectiveness of the proposed model and method.

7. Mobile Edge-Aided Data Dissemination for Wireless Healthcare Systems
Chang Shu, Zhiwei Zhao, Geyong Min, and Shuowei Chen

This article proposes an edge-aided data dissemination system, in which the mobile edge servers are used to disseminate different segments of data objects. In their work, they design the installation mechanism and data propagation protocol to not only ensure integrality of the data objects transmitted but also avoid the transmission conflicts. Furthermore, they design an adaptive protocol to achieve efficient data dissemination for heterogeneous IoT networks. Extensive experiments and large-scale simulations are conducted and their results demonstrate that compared to the existing works, edge-aided dissemination greatly improves energy efficiency and reduces the overall dissemination delay.

8. SocInf: Membership Inference Attacks on Social Media Health Data With Machine Learning
Gaoyang Liu, Chen Wang, Kai Peng, Haojun Huang, Yutong Li, and Wenqing Cheng

This article presents SocInf and focuses on the fundamental problem known as membership inference. The key idea of SocInf is to construct a mimic model which has a similar prediction behavior with the public model, and then they can disclose the prediction differences between the training and testing data set by abusing the mimic model. With elaborated analytics on the predictions of the mimic model, SocInf can thus infer whether a given record is in the victim model's training set or not. They empirically evaluate the attack performance of SocInf on machine learning models trained by Xgboost, logistics, and online cloud platform. Using the realistic data, the experiment results show that SocInf can achieve an inference accuracy and precision of 73% and 84%, respectively, in average, and of 83% and 91% at best.

9. A Fair Blockchain Based on Proof of Credit
Xuan Han, Yong Yuan, and Fei-Yue Wang

This article studies the activity considerations of nodes participating in the blochchain protocols based on proof of work and proof of stake and presents PoC, a fair blockchain protocol based on proof of credit where the credit is a special kind of stake quantifying whether the nodes activity is beneficial to the system. Any nodes cannot change their credits arbitrarily. They demonstrate that PoC protocol satisfies the security properties, including common prefix, chain quality, and chain growth, under the assumption that the total credits the honest held is the majority. In addition, they propose a self-audit mechanism and a hybrid incentive mechanism to enhance the security and stability in the PoC protocol. Finally, they show that the PoC protocol can resist the double-spending attacks and the selfish mining attacks.

10. Analytic Models of Roll Call Voting Dynamics
Thomas Magelinski and Kathleen M. Carley

This article develops a roll call model from a linear second-order homogeneous differential equation, to fit to Verkhovna Rada votes from the seventh and eighth convocations. It is shown that the dynamic legislative model is significantly more interpretable. It is found that bills sponsored by the president show quantitatively different behavior than ordinary bills, and the ordinary bills are largely decided in the first two votes. Moreover, the information from a bill's first two votes is also leveraged through a vote switching network. This directed network gives insight into who sends the most powerful signals and who follows them. An ensemble of centrality members is then used to identify the legislator's most influential members.

11. Discovering Transit-Oriented Development Regions of Megacities Using Heterogeneous Urban Data
Xiangjie Kong, Feng Xia, Kai Ma, Jianxin Li, and Qiuyuan Yang

This article focuses on leveraging heterogeneous megaurban data to answer three critical questions in transit-oriented development (TOD): what region looks like under TOD concept, which regions have the potential to be TOD regions, and how to construct these TOD regions. A connected component-based clustering algorithm is proposed for region partition, a link importance-based random walk method is presented for TOD region identification, and a multifactor-based function characterization approach is proposed for discovering functions of TOD regions. They also conduct experiments on three real data sets to show the superiority of the proposed methods, and the results can provide support for the government to formulate public policy to construct a TOD city.

12. Identify Connected Positive Influence Dominating Set in Social Networks Using Two-Hop Coverage
Hongwei Du, Caiwei Yuan, He Yuan, Shanshan Wei, and Wen Xu

This article proposes a greedy algorithm to identify connected PIDS (CPIDS) in large-scale social networks, which

utilizes hop coverage information of the nodes in the network. The simulation results show that the proposed approach outperforms existing algorithms in real-world large-scale networks in terms of time cost, and the proposed approach can be potentially used in designing efficient influence diffusion algorithms in online social networks (OSNs).

13. Centrality Analysis in d-Regular Directed Acyclic Random Networks and Its Applications in Top-k Recommendations

Ping-En Lu, Cheng-Shang Chang, Duan-Shin Lee, and Ching-Chu Huang

Centrality analysis has always been a very important research topic in online social networks. Traditionally, central analysis has been performed on specific networks. In this article, centrality analysis is performed in random networks. Specifically, the authors consider the class of d-regular directed acyclic random networks and two centralities, the PageRank and the in-component centrality. For the PageRank, they get a closed-form solution in a complete directed acyclic network and show that it can be used as an approximation in a d-regular directed acyclic random network. For the in-component centrality, they derive the upper bounds for its first moment and its second moment in a d-regular directed acyclic random network. These results have interesting applications in top-k recommendations. In particular, a qualifying round algorithm is proposed which outputs a set of nodes to include the top-k nodes with high probability. Various experiments are performed to show the effectiveness of the algorithm.

14. Summarizing Situational Tweets in Crisis Scenarios: An Extractive-Abstractive Approach

Koustav Rudra, Pawan Goyal, Niloy Ganguly, Muhammad Imran, and Prasenjit Mitra

This article proposes a classification-summarization framework for summarization of situational tweets stream in crisis scenarios. In the summarization phase, they propose a novel two-step extractive-abstractive summarization framework that satisfies two major requirements (i.e., information coverage, real time) during disasters. And apart from general classwise summarization, they also show the customization of their summarization model to address time-critical sparse information needs (e.g., missing relatives). Their proposed method is time and memory efficient and shows better performance than state-of the-art methods in terms of both quantitative and qualitative judgment.

15. A Feedback Mechanism with Bounded Confidence-Based Optimization Approach for Consensus Reaching in Multiple Attribute Large-Scale Group Decision-Making

Quanbo Zha, Haiming Liang, Gang Kou, Yucheng Dong, and Shui Yu

This article proposes a large-scale consensus model with a bounded confidence-based feedback mechanism to promote the consensus levels among decision-makers with bounded confidences. Specifically, this feedback mechanism classifies the decision-makers into different clusters and provides the corresponding clusters with more acceptable advices based on a bounded confidence-based optimization approach. Finally, through the numerical example and the simulation analysis, the use of the model is introduced, and the effectiveness of the model is justified.

16. Finding Emergent Patterns of Behaviors in Dynamic Heterogeneous Social Networks

Benjamin W. K. Hung, Anura P. Jayasumana, and Vidarshana W. Bandara

This article provides a comprehensive version of a graph pattern matching technique called Investigative Search for Graph Trajectories (INSiGHT) to find emergent patterns of behaviors in networks and tailor the application to detecting radicalization in the homeland security domain. The parameterized methods are provided to score multiple occurrences of indicators and to dampen the significance of indicators over time, respectively. In addition, an indicator categorization scheme and a match filtering technique are used to ensure that partial matches to the most salient indicators are identified while reducing the number of false positives. Furthermore, the article introduces a noncombinatorial neighborhood matching technique that enables analysts to use INSiGHT to identify potential query matches from clusters of individuals who may be operating in conspiracies. Finally, both the synthetic radicalization data set and the real-world data set of the BlogCatalog social network are used to evaluate the proposed approach.

17. HiRecS: A Hierarchical Contextual Location Recommendation System

Ramesh Baral, S. S. Iyengar, Xiaolong Zhu, Tao Li , and Pawel Sniatala

This article proposes a hierarchical recommendation model termed Hierarchical Contextual Location Recommendation System (HiRecS), which formulates users' preferences as a hierarchical structure and models the locality trend using aggregated hierarchy. For a locality, the root of hierarchy contains preferred k items from a set of visitors, and the subsequent levels contain preferencewise subsets of those items. A hierarchy aggregation technique is also presented to aggregate the hierarchical preferences from a similar set of users. The aggregated hierarchy is then contextually exploited for POI sequence recommendation. The proposed model is also evaluated with two real-world data sets.

Social Manufacturing

SM is a novel concept developed from social computing in 2012 [1], [2], and it has been regarded as an innovative manufacturing solution for the coming personalized customization era. SM can realize customers' requirements of "From Mind to Products," and fulfill both the tangible and intangible needs of prosumers (e.g., producer and consumer at the same time). It is believed that SM is the inevitable trend of future manufacturing and it will become more and more popular across various sections [3]–[8].

In fact, the essence of social manufacturing is the cyber–physical–social systems (CPSS), which extends the social aspect into cyber–physical systems (CPS). In the physical aspect, 3-D printers or intelligent machining centers, industrial robots, and Internet of Things provide strong physical support for effective communication and transparent management in manufacturing enterprises. In the social aspect, Cyber Movement Organizations (CMO) are introduced and

analyzed based on social media and social networks. In the cyber aspect, cloud/edge computing, social computing, and big data analysis are adopted to mine the industrial and social big data for sharing and decision making. Therefore, with CPSS, SM can achieve the flexible mass customization through control and management of the physical and socialized resources.

During the past eight years, the concept of SM has attracted a lot of attentions from researchers, and the SM technologies and applications have been well studied by many researchers in related fields. Jiang [9], Jiang *et al.* [10], and Yang and Jiang [11] have studied the core aspects of SM, and they also proposed the future directions of SM. Ding and Jiang [12] gave the model and analysis of an enterprise relationship network in the context of SM. Hamalainen *et al.* [8] proposed the value chain design and analysis of SM Ecosystem. Shang *et al.* [4], [5] and Xiong [6] constructed the footwear and apparel SM systems. With the development of intelligent manufacturing, 5G Network, and personalized product consumption, SM mode is developed quickly.

The research progressess of SM as well as its future research directions include the following aspects.

1) The basic theories including the SM paradigm, the architecture, configuration and execution of SM systems, modeling and analysis of CPSS for manufacturing, value chain design and analysis, ecosystems and business modes, transformation modes to SM, and so on.
2) The supporting technologies including open product design; big data; artificial intelligence-driven 3-D scanning, modeling, and printing; digitalization; IoT and social networked factory; social business relationships and organizational networks; blockchain models in cybersecurity; and social media cloud platforms.
3) The applications including high-end wearable product, healthcare product, industrial product, education product, entertainment product, and so on.

Theories Research of Social Manufacturing

SM is a novel manufacturing paradigm based on technologies such as 3-D, IoT, cloud computing, social networks, and big data, and it can realize distributed, collaborative, service-oriented, intelligent, and customized production. There are three types of modes for SM, including the basic SM mode supported by traditional subtractive manufacturing, the novel SM mode supported by additive manufacturing (3-D printing), and hybrid SM mode supported by both the subtractive and additive manufacturing, in which for a product, some parts should be made by basic SM mode, and other parts should be made by novel SM mode. The theoretical framework of SM includes the following three parts.

1) *Architecture of SM:* Including the definition, logical framework and the models of SM. As SM ecosystem is a complex social system, CPSS can be regarded as an efficient and effective approach for modeling SM.
2) *Value Chain Analysis:* Compared with the mass customization, the value chain design and analysis of SM ecosystem are important.
3) *SM Modes:* Including the comparisons, analysis, and models of the three SM modes.

Supporting Technologies of Social Manufacturing

There are several key supporting technologies for implementing SM digitalization (e.g., 3-D scanning, 3-D modeling, and 3-D printing), including blockchain, IoT, cloud computing, 5G network, and so on. These technologies can be used in measurement, information collection, information transmission, big data processing, and real-time monitoring for mass customization.

These technologies and tools can be combined to promote multidisciplinary integration. As such, some new interdisciplinary technologies in SM are emerged.

1) *3-D Scanning and 3-D Modeling:* In order to collect the customization information, 3-D scanning and modeling are studied to improve the precision. A hybrid algorithm combining a normal aligned radial feature (NARF) key point detector and fast point feature histogram (FPFH) descriptor is used for the 3-D foot registration and modeling. The NARF key point detector can accelerate the efficiency of the initial iteration, while the FPFH can reduce the calculation for the matching process based on a decrease in the descriptor dimension.

2) *Industrial 3-D Printing:* 3-D printing has been developed rapidly in recent years with an intense demand for mass customization. However, the accuracy of the 3-D printed objects is low compared with traditional methods. The main reason is that the shape of the model to be printed can be arbitrary and its quantity is usually small, so that the deformation is affected by the shape of the object and there is a lack of a universal method for the error compensation. It is neither easy nor economical to perform the compensation manually, as such, a framework for the automatic error compensation has been proposed.

3) *Blockchain:* Blockchain technology is a relatively new research area and has attached more and more attentions. Blockchain is a distributed and electronic database (ledger), which can hold any information (e.g., records, events, and transactions) and set rules for updating these informations. The blockchain increases when new blocks are appended, where new blocks can be found by hashes. The hash is produced by running contents of the block through a cryptographic hash function, which can easily produce a hash for any input, but it is almost impossible to use the hash to derive the input. The ledger is validated and maintained by a network of participants (nodes) according to the consensus. Therefore, the best advantage of blockchain is that multiple (but not necessarily all) nodes hold a full copy of the entire database instead of one single centralized authority [13]–[16].

4) *From Social Computing to SM:* The main challenge of SM is how to effectively make use of CMO, i.e., the group who dynamically access the Internet for the similar interests or purposes. Through the processes of data collection, storage, fusion, and analysis, we can not only detect CMO's hot trend, dissemination, and evaluation, but also CMO's population types, distribution, organizational structure, and social network relationship. Furthermore, the interactive behavior and product

consumption personality of individual Internet user can also be obtained.

Applications of Social Manufacturing

Based on the theory framework and supporting technologies, SM can be applied in the footwear and apparel industries, 3-D printing, and energy production and consumption.

1) Social Manufacturing for Footwear Customization

Compared with footwear mass customization, the proposed SM system has socialized attributes including SM resource (SMR) utilization, collaborative management of SMRs, and the support of social networks and social media. The key for implementing SM in the footwear industry is determining how to make the best use of these socialized attributes to execute accurate, effective, and intelligent customized production. For the prosumers, their own fashion shoes can be customized through crowd sourcing and SMRs. For the providers, the footwear producers, designers, workshops, and logistics service providers, public warehouse providers can be self-organized and can collaborate for footwear production in the social media-based community of SM.

2) Social Manufacturing for Apparel Customization

The system can supply the whole solution for the apparel industry, mainly including 3-D fitting mirror technology, personalized design and customization, and service mode combing online and offline sales. For realizing this novel SM, the main research issues include the following four aspects: 1) 3-D fitting mirror technology; 2) clothing customization subsystem; 3) collaborative production management for the customization; and 4) other supplying technologies, for example, cloud computing, IoT (Internet of things), and 5G. SM for apparel customization is the future trend of apparel customization in intelligent society and can be applied widely.

3) Social Manufacturing System Supported by 3-D Printing

For dental crowns customization, SM system supported by 3-D Printing can be studied. As a direct manufacturing technology, 3-D printing holds great promise. Unlike traditional manufacturing techniques that mostly rely on the removal of material by methods, such as cutting or drilling, it adds material layer by layer directly following the computer-aided design (CAD). Manufacturing action can be executed online by the interconnected 3-D printers and other production equipment on net. As online services and software spread more widely, customers are allowed to take part in the production process, so that the customization of manufacturing can be well finished. The customized products can be made economically in much smaller numbers, more flexibly and with a much lower input of labor through the new processes such as 3-D printing, easy-to-use robots and new collaborative manufacturing services available online.

4) SM for Energy Production and Consumption

With the development of renewables-based electricity generation, decentralized electricity generation will be a major aspect of global energy transition and decarbonization initiatives, such as the decentralized manufacturing. Therefore, SM for energy production and consumption is proposed to balance the energy production and consumption. The principle of SM is expanded from discrete manufacturing to electricity generation. In the SM, the consumers are transformed from buyers to prosumers, and they are interconnected on the power grid. Therefore, it is regarded as a novel feasible solution for energy production and consumption of intelligent power grid [17].

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