Federated Ecology: Steps Toward Confederated Intelligence

WELCOME to the second issue of IEEE TRANSACTIONS ON COMPUTATIONAL SOCIAL SYSTEMS (TCSS) this year. First, I am grateful to report that, as of February 7, 2021, the *Citescore* of TCSS has leapfrogged back to 5.8, a new high, which indicates the high quality and relevance of IEEE TCSS in the field of social computing and computational social systems research. Many thanks to all of you for your great effort and support.

After the usual introduction of our 21 regular articles, I would like to discuss the topic of federated ecology, a new way to address the problem of isolated data island in the era of big data. The concept of federated ecology was proposed based on blockchain technology and the premise of controllable data privacy. It can realize data federation, federated service, and then confederated intelligence for releasing the great potentials of big data and artificial intelligence.

I. Scanning the Issue

1. "Donald J. Trump's Presidency in Cyberspace: A Case Study of Social Perception and Social Influence in Digital Oligarchy Era"
Xiaolong Zheng, Xiao Wang, Zepeng Li, Rongrong Jing, Shuqi Xu, Tao Wang, Lifang Li, Zhenwen Zhang, Qingpeng Zhang, Huaiguang Jiang, Zhihua Guo, Xiaowei Zhang, and Fei-Yue Wang

This article introduces a large-scale empirical study on social perception and social influence regarding the Trump phenomenon from personal perception, media, and public attention perspectives. First, they investigate Trump and Biden's sentiment and opinion evolution and analyze their underlying personality traits based on the tweets posted by them. Then, they explore the dynamic patterns of Trump's interactive social networks based on Twitter interaction relations. Finally, they construct public attention networks based on Google search information and further reveal the underlying public perception regarding Trump, Obama, and Biden. They find that Trump's perception can be affected by the occurrent social events and the corresponding social factors. Moreover, there exist obvious correlations between the posting behavior of Trump and the attention of news media.

2. "Content-Aware Galaxies: Digital Fingerprints of Discussions on Social Media"
Pouria Babvey, Dario Borrelli, Carlo Lipizzi, and Jose Emmanuel Ramirez-Marquez

To visually summarize social media content, this article introduces a method in which discussion threads as the network between tweets are considered as the main components. Based on it, they propose a framework to provide a high-level overview of a Twitter stream. Also, a metric energy is introduced to quantify the spread of the discussion initiated by a tweet. They integrate some recently developed text analysis methods into the model to extract the topic, sentiment and stance of the tweets toward a controversial topic, and the coherency between the tweet-reply pairs. Finally, they visualize the content-aware galaxies.

3. "A Community Detection Method for Social Network Based on Community Embedding"
Meizi Li, Shuyi Lu, Lele Zhang, Yuping Zhang, and Bo Zhang

Considering nodes' influence information, nodes' community affiliating information, and similarity of community topologies, this article introduces a model on node representation learning. They also propose an overlapping communities detection method based on network representation learning that combines node embedding, community embedding, and clustering. The generalization of the method on larger data sets will be examined.

4. "Where Are WeChat Users: A Geolocation Method Based on User Missequence State Analysis"
Wenqi Shi, Xiangyang Luo, Jiadong Guo, Chong Liu, and Fenlin Liu

This article introduces a WeChat user geolocation method based on user missequence state analysis (MSAG) is proposed. MSAG utilizes the relation between user order and actual distances to geolocate the target. By statistical analysis of sequence changes of nearby users under different actual distances, the distance range that causes nearby users missequence is determined. During geolocation, the distance range of the target is delimited by checking the missequence state of the target and a user with a known location. Finally, the efficient trilateration model is also utilized and improved to geolocate the target.

5. "BullyNet: Unmasking Cyberbullies on Social Networks"
Aparna Sankaran Srinath, Hannah Johnson, Gaby G. Dagher, and Min Long

This article introduces a three-phase algorithm, BullyNet, for detecting cyberbullies on Twitter social network. They performed extensive research on mining SNs for a better understanding of the relationships between users in social media, to build a signed network based on bullying tendencies. There are still several open questions, such as, investigate images and videos instead of extracting emotions and behavior from texts and emojis in tweets, how to distinguish bullies from aggressors, and so on.

6. "A Dynamic Information Dissemination Model Based on Implicit Link and Social Influence"
Xinhong Wu, Yunpeng Xiao, Xia Liang, and Qian Li

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This article introduces a dynamic model for information dissemination based on the implicit link and social influence. First, they excavate implicit relationships among users to strengthen friends' influence in driving information dissemination and then establish a more accurate network topology. Second, they extract the individual and friend driving mechanisms based on the accurate network topology, analyze the causes of two information dynamics, and measure social influence based on a multiple linear regression model. Finally, considering the timeliness and uncertainty of information dissemination in an infectious disease model, they introduce the mean-field theory and obtain an information dissemination model based on social influence. They find that the implicit link plays an important role in driving user behavior.

7. "Effective Visibility Prediction on Online Social Network"
Nemi Chandra Rathore and Somanath Tripathy

This article introduces an exponential model to measure the visibility of tweets exploiting the trust and interest of the followers. Furthermore, they develop a polynomial regression model and a deep neural network model for visibility prediction. All of the models can be easily adapted for other online social networks as well. It may be interesting to explore whether other centrality attributes have any impact on the visibility of a resource, such as betweenness, closeness of the owner, and forwarding users.

8. "A Graph-Based Socioeconomic Analysis of Steemit"
Barbara Guidi, Andrea Michienzi, and Laura Ricci

This article evaluates the characteristics of the Steemit follower–following graph to understand how the social and the economic aspects of blockchain online social medias intertwine and influence each other. They study the properties of the Steemit follower–following graph and a few selected hotspot contents. The analysis shows that users are highly encouraged to be socially active, especially producing content, but the richest users are not also the most social ones, which suggests us that users can get rich without much involvement in the platform, using external mechanisms.

9. "Socio-Aware Recommendations Under Complex User Constraints"
Konstantinos Tsitseklis, Margarita Vitoropoulou, Vasileios Karyotis, and Symeon Papavassiliou

This article studies the joint behavior of an information diffusion process integrated with a recommender system over an online social network, where each user is assumed to have a threshold for processing information. Based on this, they considered the information diffusion process that unfolds in the social platform as a supplemental mechanism of recommendations and proposed two algorithms, which aim to allocate the items for a recommendation in order to maximize users' total relevance, while ensuring that no user exceeds his information capacity. The proposed framework can diffuse almost all the items in the network while achieving relevance scores close to the optimal.

10. "A Lightweight Scheme Exploiting Social Networks for Data Minimization According to the GDPR"
Gianluca Lax and Antonia Russo

This article introduces a method that allows individuals to control the information shared with other actors by using very efficient operations, such as the exclusive-OR function, the hash function, and the pseudorandom number generator. The method is based on the use of social networks. A service provider can verify the attributes of a user by the support of the social network as a secure and transparent repository of the selected and hidden information.

11. "Fundamental Limits of Data Utility: A Case Study for Data-Driven Identity Authentication"
Qing Yang, Cheng Wang, Changqi Wang, Hu Teng, and Changjun Jiang

This article focuses on measuring the fundamental limits of data utility from the perspective of data distribution. They present a primary analytical framework for information-theoretic bounds of data utility. It utilizes the current state-of-the-art and representative algorithms to obtain the achievable lower bounds on a real-world data set. First, they propose the definition of fundamental limits of data utility. Then, they present the main study results on Shannon's upper bound and Renyi's upper bound on prediction accuracy, which provides insight about exploration and utilization of data utility in advance. Finally, they calculate the achievable lower bounds on a real identity fraud data set. The tighter upper bound of data utility can be explored from more dimensions.

12. "A Data-Driven Analysis of Employee Development Based on Working Expertise"
Jiamin Liu, Jingbo Huang, Tao Wang, Lining Xing, and Renjie He

This article aims to confirm the effect of expertise and find out how expertise affects development. The authors put forward ideas on a data-driven solution to employee development issues and makes preliminary practice in a Chinese state-owned enterprise. The expertise networks are constructed, and a prediction model of development potential is proposed based on machine learning. Finally, this article shows that the proposed model is effective in identifying excellent workers. They also discover four rules that can reflect how expertise affects employee development, including the post is especially important, choices matter most, less is better, and changes lead to success.

13. "A Prediction Method of Publication Productivity for Researchers"
Zheng Xie

This article proposes a model for the publication dynamics of researchers. The model is based on Lotka's law, the relationship between the annual number of publications and time given a historical number of publications, and the evidence that a piecewise Poisson process characterizes most researchers' productivity patterns. Then they validate the law and the statistical significance of the relationship is by applying them to the high-quality dblp data set. The model allows predicting the number of publications for research groups. The proposed model renders evolution trajectories relatively predictable on average, which would reveal the mechanisms governing the evolution of researchers' publication productivity.

14. "Target Tracking Applied to Extraction of Multiple Evolving Threats From a Stream of Surveillance Data"
Zachariah Sutton, Peter Willett, and Yaakov Bar-Shalom

This article presents a detection scheme based on random finite set filters—Specifically a multi-Bernoulli approach—Which allows for detecting multiple threat processes using a single observed data stream. Their evaluation now provides for various threats to exists and be extracted. They further have augmented the model to admit "identity" information: transactional data often involves actors and places, etc. Finally, they develop a particle filter version of the Bernoulli filter.

15. "Cloud/Edge Computing Resource Allocation and Pricing for Mobile Blockchain: An Iterative Greedy and Search Approach"

Yuqi Fan, Lunfei Wang, Weili Wu, and Dingzhu Du

This article proposes a Stackelberg game with a cloud/edge computing service provider (CESP) as the leader and users as followers for cloud/edge computing resource management. Firstly, they prove the existence of Stackelberg equilibrium and analyze the equilibrium. They propose an efficient Iterative Greedy-and-Search-based resource allocation and pricing algorithm to solve the resource allocation under a given resource price and resource pricing based on a specified resource allocation scheme. They show that the proposed algorithm can increase the revenues of both the CESP and the users.

16. "Player Behavior Modeling for Enhancing Role-Playing Game Engagement"

Sha Zhao, Yizhi Xu, Zhiling Luo, Jianrong Tao, Shijian Li, Changjie Fan, and Gang Pan

This article proposes a framework to model game behaviors to learn behavior patterns of human players. The learned behavior patterns generate human-like action sequences that can be used to design believable virtual characters in RPGs to enhance game engagement. They propose a long-term memory cell on actions and game context to learn the hidden representations. They also introduce an attention mechanism to measure the contribution of the actions previously performed to the next action. Then, they evaluate the model on a real-world data set of over 22 000 players and more than 51 million action logs of an RPG game in 21 days. The proposed model can generate action sequences and predict players' next action, which can improve player experience in games.

17. "Increasing Trust in Development Processes Using Robust, Data-Driven Markov Games: An Application to PRESTIGE"

R. Reid Bishop, Alexander V. Outkin, Brandon K. Eames, and Chelsea C. White, III

This article focus on how to increase trust in development processes. First, they show how to model dynamic agent interaction, based on partially observed or noise corrupted data, using a partially observable Markovgame (POMG) framework. Then, they propose a threefold heuristic solution procedure that 1) uses the POMG to generate potential adversarial policies; 2) explicitly incorporates these adversarial policies in the construction of a robust defender policy by solving a robust dynamic program; and 3) employs a probability matching heuristic in partially observable environments. Finally, they point out several limitations in their approach that create future research directions.

18. "Memory Augmented Hierarchical Attention Network for Next Point-of-Interest Recommendation"

Chenwang Zheng, Dan Tao, Jiangtao Wang, Lei Cui, Wenjie Ruan, and Shui Yu

This article provides a memory augmented hierarchical attention network (MAHAN), which considers both short-term check-in sequences and long-term memories. They design a spatiotemporal self-attention network (ST-SAN) to capture users' complicated interest tendencies within a short-term period. For long-term preferences modeling, they use a memory network to maintain the fine-grained preferences of users. Moreover, to thoroughly learn the dynamic interaction between long- and short-term preferences, they first employ a co-attention network/mechanism to integrate the proposed ST-SAN and memory network. Finally, they conduct extensive experiments on two real-world LBSN data sets. The results demonstrate that MAHAN significantly outperforms state-of-the-art methods in different evaluation metrics and can better mitigate data sparsity problems.

19. "Cognitive Analytics of Social Media Services for Edge Resource Pre-Allocation in Industrial Manufacturing"

Dawei Zhu, Zhanyang Xu, Xiaolong Xu, Qingzhan Zhao, Lianyong Qi, and Gautam Srivastava

This article presents a resource pre-allocation (RPA) method for social media services with cognitive analytics to deal with the challenge of optimizing the load balance of ESs while meeting latency-critical requests. The proposed method consists of three key steps: 1) using a deep spatiotemporal residual network to complete the cognitive analytics of resource requests; 2) based on the analysis results, they designed the optimal resource allocation scheme with multi-objective optimization; and 3) evaluate the performance of RPA by a real-world resource request data set. The proposed method shows favorable performance.

20. "Toward Next Generation of Blockchain Using Improvised Bitcoin-NG"

Debasis Das

This article discusses a new mechanism for blockchain by introducing a new leader election scheme in the blockchain, aiming to reduce the consensus delay, reduce energy consumption, and increase the throughput. Because blockchain enables Internet of Things (IoT) devices to enhance security and bring transparency to IoT ecosystems, they combined blockchain with the IoT. They proposed a scheme that provides secure authentication and efficient communication for different IoT devices. The graph from experimental values verifies that consensus delay has been reduced using key block architecture in Bitcoin-NG using their proposed scheme. Moreover, reducing the average number of mining operations makes the process energy-efficient and computationally lighter. The proposed schemes perform better than other schemes.

21. "EigenCloud: A Cooperation and Trust-Aware Dependable Cloud File-Sharing Network"

Xing Jin, Mingchu Li, Zhen Wang, Cheng Guo, Hong Ding, and Yong Guan

This article introduces a dependable cloud file-sharing scheme—EigenCloud—to solve the two severe challenges: cooperation dilemma and trust dilemma. First, they propose a modified Eigen Trust algorithm to calculate each cloud user's global cooperation value and global trust value based on her past behaviors. Second, by determining a Pareto front from all cloud users, they propose cooperation and a trust-aware worker recommendation mechanism. These can make a cloud user who adopts the recommendation mechanism by paying an additional fee could have a higher probability of receiving a valid file in one transaction. Finally, they use evolutionary game theory (EGT) to study the acceptance and effectiveness of the proposed EigenCloud and illustrate that their EigenCloud has an outstanding performance in promoting cooperation and inhibiting malicious activity.

II. Federated Ecology: Steps Toward Confederated Intelligence

In the era of cloud computing and artificial intelligence, the value of big data has been constantly developed, but at the same time, the problems of user privacy leakage, data monopoly, and fairness are becoming more and more prominent. As such, data privacy protection and information security have attracted a lot of attention, and relevant laws and regulations are promulgated to limit the transitional use of data, which lead to more and more serious isolated data island issues, and limited the applications and values of data greatly. In order to solve such issues, the concept of federated ecology was proposed [item 1) in the Appendix], [item 2) in the Appendix], and it is regarded as an efficient way to realize the effective use of data in the service scenario of data decentralization under the premise of ensuring information security [item 3) in the Appendix].

Federated ecology can also provide an effective solution for the coming era of the IoT, where almost every object has the abilities of data processing, and data analysis based on the data from one node often reduces the scalability of the model. Federated ecology can achieve the effective use of data by combining the data and computing resources of each node and build the node federation through management and control. It can provide high-quality services based on group data and computing resources under the premise of controllable node data privacy, and thus becomes an important way to realize swarm intelligence.

Different from the existing technologies that deal with the issues that existed in distributed scenes, such as distributed storage, edge computing [item 4) in the Appendix], blockchain technology [item 5) in the Appendix], and federated learning technology [item 6) in the Appendix], which can only focus on one aspect in the distributed scene and lack of overall consideration and coordination of the system, federated ecology can deal with the issues in the whole process from data production to data use and then to service and intelligence. Federated ecology was proposed based on the idea of intelligent ecosystem research and has the ability of transforming data into intelligence. It takes full advantage of big data and artificial intelligence technologies and has the ability to break the isolated island of data. Federated ecology provides a new idea for the realization of confederated intelligence. It can not only be applied to federations with central leading nodes but also to federations with weakened or missing central nodes. With federated ecology, the cooperative relationships can be established among the federated nodes through a loose alliance, which can strengthen the privacy protection of each node, mobilize the enthusiasm of federated nodes, and improve the participation of federated members, and thus can better complete external services and improve the overall performance of the federation.

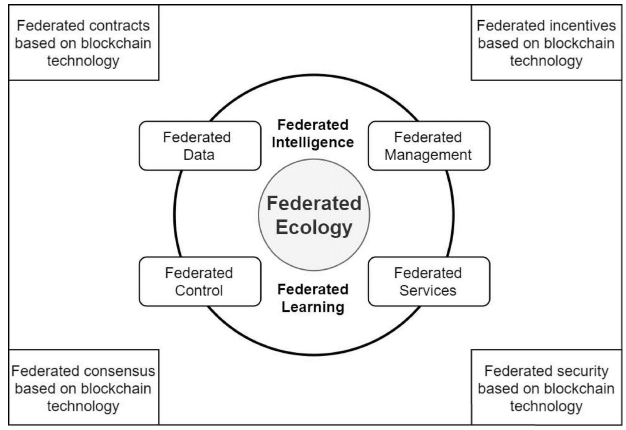

Fig. 1. Basic framework of federated ecology.

III. Framework for Federated Ecology

Federated ecology refers to a unified framework for privacy protection, data security, and collaborative resource management among distributed federated nodes. It consists of federated data, federated control, federated management, federated services, and is supported by blockchain-based federated security, federated consensus, federated incentives, and federated contracts (as shown in Fig. 1). Federated control is responsible for dispatching and controlling federated data and then realizing data federalization, and federated management is responsible for making rules for federated services and realizing the federalization of services. On the premise of privacy and controllable data exchange, federated ecology can realize data federation through federated control, and service federation through federated management. With the support of federated security, federated consensus, federated incentives, and federated contracts, the safety and stability of the entire federated ecology can be guaranteed.

In general, federated ecology can realize the industrial chain from upstream data, midstream technology to downstream applications, and it can help achieve effective use of data while protecting data privacy and meeting copyright and regulatory requirements. In addition, federated ecology can alleviate information asymmetry and effectively prevent the occurrence of data monopoly. It can also establish trust among federated nodes, maintain a trusted distributed system, and promote the automated transformation from data and services to intelligence.

IV. Key Issues in Federated Ecology

Federated ecology aims to build a privacy protection collaboration mechanism and provide intelligent services to satisfy

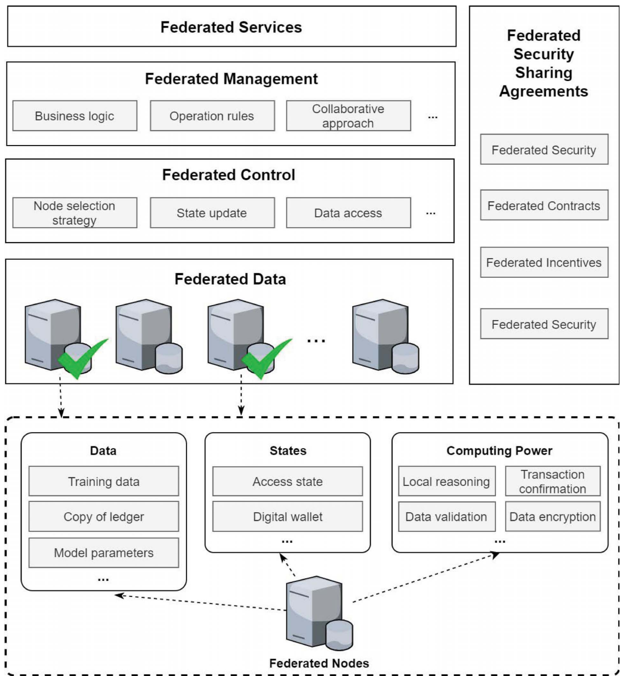

Fig. 2. Hierarchical structure of federated ecology.

the requirements of the clients. The key issue of federated ecology is how to safely bridge the gap between social services and engineering implementation on the premise of privacy protection and abiding by laws and regulations. Specifically, federated ecology needs to develop management strategies for social problems and services, and implement such strategies into real systems and solve the corresponding engineering problems. There are four key components in federated ecology, including federated services, federated management, federated data, and federated control (as shown in Fig. 2).

A. Federated Services and Federated Management

Federated ecology can provide federated services, i.e., diverse intelligent solutions, for different users and scenarios. The privacy protection in federated services can avoid the legal and moral problems related to data privacy. Besides, federated services are provided based on distributed systems, and it can greatly reduce the cost of centralized data storage.

Federated management is the first step to achieve federated services. It decomposes the overall objective into sub-tasks for different nodes in the federation and sets up the rules and strategies to manage all the components. During the process of decision-making, social factors such as policy, law, profit, and engineering factors such as storage, commutation need to be considered simultaneously. Through federated management, we can obtain a set of strategies and rules defining the actions of each node in the federation, as well as how they will cooperate with each other.

B. Federated Data and Federated Control

Federated data is the foundation of the whole ecology. It not only comprises the data from different nodes in the federation but also their storage, computation, and communication resources. To protect privacy, the local data of each node will be divided into private data and nonprivate data. Private data can only be stored and used locally, while nonprivate data can be sent to other members in the federation to update global states of the federation.

Federated control converts the strategies and rules defined by federated management to codes or scripts, which can achieve the effective control of federated data. It directly controls the access status of each node and the flow of public information. Under federated control, the overall objectives of the system are divided into multiple subobjectives and assigned to different nodes in the federation, where local resources are used to achieve the subobjectives.

V. Key Technologies of Federated Ecology

The key technologies of federated ecology include federated contract, federated consensus, federated incentive mechanisms, and federated security.

A. Blockchain-Based Federated Contract

The federated contract is defined as a set of autonomous scripts, codes, and their derivatives that are used for the management and control of the federated ecology [item 7) in the Appendix]. It can be flexibly designed according to the services and requirements of the clients, and it will execute automatically according to the strategies and rules formulated in the federated contract.

B. Blockchain-Based Federated Consensus

In a decentralized federated ecology, the consensus between different federated nodes is necessary for the stable and consistent running of the ecology. Federated consensus is derived from the consensus in blockchain [item 8) in the Appendix], and it decides when a node can legally devise the global information and how other nodes validate the legality of the changes.

C. Blockchain-Based Federated Incentive Mechanisms

To avoid the inconsistency of profits between the local federated nodes and global federated ecology, federated incentive mechanisms integrate the reward and punishment mechanism to evaluate the contribution of each federated node. With these mechanisms, the activeness of the ecology can be maintained, and global optimization objectives can be achieved.

D. Blockchain-Based Federated Security

Privacy security is the primary requirement in federated ecology. By storing and computing the private data locally, federated ecology can avoid the leakage of privacy. In addition, based on blockchain technology, data security in information transmission, modification, and verification among federated nodes can also be guaranteed.

VI. Federated Applications

Federated ecology has a wide range of application scenarios, such as the financial industry, medical industry, and autonomous driving industry. Due to industry sensitivity and many other reasons, data in these fields often cannot be directly exchanged and shared, which limits the effective use of data. Federated ecology can provide an integrated and secure sharing environment for the above scenarios, maximize data benefits under the premise of controllable privacy, and help the industry's development and progress. For example, when a hospital makes a medical diagnosis for a patient, it can improve the accuracy of diagnosis by using the previous diagnosis results of the patient from multiple hospitals through the intelligent diagnosis model in the federated ecology.

VII. Toward Confederated Intelligence

In the big data era, the problem of isolated data island has seriously restricted the training processes and applications of artificial intelligence models. With the frequent occurrence of network security incidents and serious privacy leakage, data privacy protection is attracting more and more attention, and a series of relevant regulatory measures have been promulgated and implemented, which makes data collection and sharing more difficult. As such, we propose the basic idea of federated ecology, aiming to provide intelligent solutions for specific application scenarios and distributed data by connecting data and services.

Federated ecology involves many fields such as machine learning algorithms, distributed machine learning, cryptography and security, privacy-preserving data mining, game theory, and so on. We aim to study the federated control and regulation methods, federated management strategies, and the formulation of the federated security sharing agreement in federated ecology, and explore its applications in transportation [item 9) in the Appendix], [item 10) in the Appendix], visual computing [item 11) in the Appendix], social computing [item 12) in the Appendix], [item 13) in the Appendix], and smart agriculture [item 14) in the Appendix] in the future. We believe it has the ability to break the problem of isolated data island and provide a new idea for transforming federated data to confederated intelligence.

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Appendix
Related Work

1) F.-Y. Wang *et al.*, "Federated ecology: From federated data to federated intelligence," *Chin. J. Intell. Sci. Technol.*, vol. 2, no. 4, pp. 305–311, 2021.
2) F.-Y. Wang and Y. Wang, "Parallel ecology for intelligent and smart cyber-physical-social systems," *IEEE Trans. Comput. Social Syst.*, vol. 7, no. 6, pp. 1319–1324, Dec. 2020.
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Fei-Yue Wang (Fellow, IEEE) received the Ph.D. degree in computer and systems engineering from the Rensselaer Polytechnic Institute, Troy, NY, USA, in 1990.

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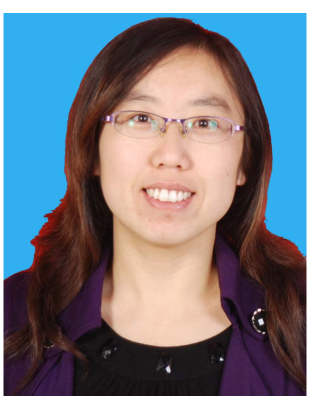
Dr. Wang was elected Fellow of the International Council on Systems Engineering (INCOSE), the International Federation of Automatic Control (IFAC), the American Society of Mechanical Engineers (ASME), and the American Association for the Advancement of Science (AAAS). He received Best Paper Awards for his work from the IEEE Intelligent Transportation Systems Society (ITSS) in 2012, the Computational Intelligence Society in 2017, as well as the Franklin V. Taylor Memorial Award and the Andrew P. Sage Award from the IEEE Systems, Man, and Cybernetics Society (SMCS) in 2002 and 2019, respectively. In 2007, he was a recipient of the National Prize in Natural Sciences of China and was awarded the Outstanding Scientist by Association for Computing Machinery (ACM) for his research contributions in intelligent control and social computing. He was a recipient of the IEEE ITS Outstanding Application and Research Awards in 2009, 2011, and 2015; and the IEEE SMC Norbert Wiener Award in 2014. He was the General or Program Chair of more than 50 IEEE, Institute for Operations Research and the Management Sciences (INFORMS), IFAC, INCOSE, ACM, ASME, and other professional conferences. He was the President of the IEEE Intelligent Transportation Systems (ITS) Society from 2005 to 2007, the Chinese Association for Science and Technology, USA, in 2005, and the American Zhu Kezhen Education Foundation from 2007 to 2008. He was the Vice President of the ACM China Council from 2010 to 2011 and the Chair of IFAC Technical Committee (IFAC TC) on Economic and Social Systems from 2008 to 2014 and 2017–2023. He is the President of the IEEE Council on Radio Frequency Identification (RFID) and Vice President of the IEEE SMC Society. He was the Vice President and the Secretary General of the Chinese Association of Automation from 2008 to 2018, and its President of Supervision Council since 2018. He was the Founding Editor-in-Chief of *International Journal of Intelligent Control and Systems* from 1995 to 2000, *IEEE ITS Magazine* from 2006 to 2007, and *IEEE/CAA Journal of Automatica Sinica* from 2014 to 2017. He was the EiC of IEEE INTELLIGENT SYSTEMS from 2009 to 2012, IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS from 2009 to 2016, and IEEE TRANSACTIONS ON COMPUTATIONAL SOCIAL SYSTEMS from 2017 to 2020; and the Founding EiC of *Chinese Journal of Command and Control* as well as *Chinese Journal of Intelligent Science and Technology*.



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