

Title: E-CARGO and Role-Based Collaboration

Speaker: Haibin Zhu, PhD, Professor, Nipissing University, Canada

ABSTRACT

Role-Based Collaboration (RBC) is a computational methodology that uses roles as the primary underlying mechanism to facilitate collaboration activities. It consists of a set of concepts, principles, models, processes, and algorithms.

RBC and its Environments - Classes, Agents, Roles, Groups, and Objects (E-CARGO) model have been developed to a powerful tool for investigating collaboration and complex systems. Related research has brought and will bring in exciting improvements to the development, evaluation, and management of systems including collaboration, services, clouds, productions, and administration systems. RBC and E-CARGO grow gradually into a strong fundamental methodology and model for exploring solutions to problems of complex systems including Collective Intelligence, Sensor Networking, Scheduling, Smart Cities, Internet of Things, Cyber-Physical Systems, and Social Simulation Systems.

In this speech, we examine the requirement of research on collaboration systems and technologies, discuss RBC and its model E-CARGO. Related research achievements, problems, fundamental methods and their connections with other cutting-edge fields will also be discussed.

As case studies of E-CARGO, GRA is introduced. GRA can help solve related collaboration problems with the help of programming and optimization platforms. All the related Java codes can be downloaded by GitHub: <https://github.com/haibinnipissing/E-CARGO-Codes>. The speaker welcomes interested researchers and practitioners to use these codes in their research and practice and contact the speaker if there are any questions about them.

Keywords: Collaboration, Methodology, Model, E-CARGO, Role-Based Collaboration, Object, Agent, Role.

Selected References:

- [1] H. Zhu, E-CARGO and Role-Based Collaboration: Modeling and Solving Problems in the Complex World, *Wiley-IEEE Press*, to be published, 2021.
- [2] H. Zhu, "Pareto Improvement: A GRA Perspective," *IEEE Trans. on Computational Social Systems*, 2022 (Accepted), DOI: 10.1109/TCSS.2022.3157608.
- [3] L. Liang, J. Fu, H. Zhu, D. Liu, "Solving the Team Allocation Problem in Crowdsourcing via Group Multirole Assignment," *IEEE Trans. on Computational Social Systems*, 2022 (In Press), avail: <https://ieeexplore.ieee.org/document/9737691>.
- [4] B. Akbari, and H. Zhu, "Tracking Dependent Extended Targets using Multi-Output Spatiotemporal Gaussian Processes", *IEEE Trans. on Intelligent Transportation Systems*, 2022 (In Press), avail: <https://ieeexplore.ieee.org/document/9736401>.
- [5] Q. Jiang, H. Zhu, Y. Qiao, D. Liu, B. Huang, "Extending Group Role Assignment with Cooperation and Conflict Factors via KD45 Logic," *IEEE Trans. on Computational Social Systems*, 2022 (In Press), avail: <https://ieeexplore.ieee.org/document/9732178>.
- [6] R. Wachowiak-Smolikova, and H. Zhu, "Data Analytics and Visualization of Adaptive Collaboration Simulations," *IEEE Trans. on Computational Social Systems*, 2022 (In Press), avail: <https://ieeexplore.ieee.org/document/9715262>.
- [7] Q. Jiang, D. Liu, H. Zhu, Y. Qiao, and B. Huang, "Quasi Group Role Assignment with Role Awareness in Self-Service Spatiotemporal Crowdsourcing," *IEEE Trans. on Computational Social Systems*, 2021 (Accepted with minor revision), 2022, avail: <https://ieeexplore.ieee.org/document/9670447>.
- [8] L. Liu, H. Zhu, S. Chen, Z. Huang, "Privacy-aware service selection for multi-provision cloud service composition," *Future Generation Computer Systems*, vol. 126, Jan. 2022, pp. 263-278.
- [9] Q. Jiang, H. Zhu, Y. Qiao, D. Liu, and B. Huang, "Refugee Resettlement by Extending Group Multirole Assignment," *IEEE Trans. on Computational Social Systems*, 2021 (In Press), avail: <https://ieeexplore.ieee.org/document/9650702>.
- [10] Q. Jiang, H. Zhu, D. Liu, Z. He, and B. Huang, "Agent Evaluation in Deployment of Multi-SUAVs for Communication Recovery," *IEEE Trans. on Systems, Man, and Cybernetics: Systems*, 2021 (In Press), DOI: 10.1109/TSMC.2021.3130161, avail: <https://ieeexplore.ieee.org/document/9638713>.
- [11] H. Zhu, "Social Development Paradox: An E-CARGO Perspective on the Formation of the Pareto 80/20 Distribution," *IEEE Transactions on Computational Social Systems*, 2021 (In Press), DOI: 10.1109/TCSS.2021.3117559, avail: <https://ieeexplore.ieee.org/document/9576894>.
- [12] H. Zhu, "Why Did Mr. Trump Oppose Globalization? An E-CARGO Approach," *IEEE Transactions on Computational Social Systems*, vol. 8, no. 6, Dec. 2021, pp. 1333-1343.
- [13] B. Huang, H. Zhu, D. Liu, N. Wu, Y. Qiao, and Q. Jiang, "Solving Last-mile Logistics Problem in Spatiotemporal Crowdsourcing via Role Awareness with Adaptive Clustering", *IEEE Trans. on Computational Social Systems*, vol. 8, no. 3, June 2021, pp. 668-681.
- [14] H. Ma, W. Tang, H. Zhu, and H. Zhang, "Resource Utilization-Aware Collaborative Optimization of IaaS Cloud Service Composition for Data-Intensive Applications," *IEEE Trans. on Systems, Man, and Cybernetics: Systems*, vol. 51, no. 2, Feb. 2021, pp. 1322-1333.

- [15] H. Zhu, "Computational Social Simulation with E-CARGO: Comparison between Collectivism and Individualism," *IEEE Trans. on Computational Social Systems*, vol. 7, no. 6, Dec. 2020, pp. 1345-1357.
- [16] H. Zhu, "Group Multi-role Assignment with Conflicting Roles and Agents," *IEEE/CAA J. of Automatica Sinica*, vol. 7, no. 6, Nov. 2020, pp. 1498-1510.
- [17] H. Zhu, "Agent Categorization with Group Role Assignment with Constraints (GRA+) and Simulated Annealing (SA)," *IEEE Trans. on Computational Social Systems*, vol. 7, no. 5, Oct. 2020, pp. 1234-1245.
- [18] H. Zhu, "Avoiding Critical Members in a Team by Redundant Assignment," *IEEE Trans. on Systems, Man, and Cybernetics: Systems*, vol. 50, no. 7, July 2020, pp. 2729-2740.
- [19] H. Zhu, "Maximizing Group Performance while Minimizing Budget," *IEEE Trans. on Systems, Man, and Cybernetics: Systems*, vol. 50, no. 2, Feb. 2020, pp. 633-645.
- [20] D. Liu, B. Huang, and H. Zhu, "Solving the Tree-Structured Task Allocation Problem via Group Multirole Assignment", *IEEE Trans. on Automation Science and Engineering*, vol. 17, no. 1, Jan. 2020, pp. 41-55.
- [21] H. Ma, H. Zhu, K. Li, W. Tang. "Collaborative optimization of service composition for data-intensive applications in a hybrid cloud", *IEEE Trans. on Parallel and Distributed Systems*, vol. 30, no. 5, May 2019, pp. 1022-1035.
- [22] D. Liu, Y. Yuan, H. Zhu, S. Teng, and C. Huang, "Balance Preferences with Performance in Group Role Assignment", *IEEE Trans. on Cybernetics*, vol. 48, no. 6, June 2018, pp. 1800 - 1813.
- [23] H. Zhu, Y. Sheng, X.-Z. Zhou, Y. Zhu, "Group Role Assignment with Cooperation and Conflict Factors", *IEEE Trans. on Systems, Man, and Cybernetics: Systems*, vol. 48, no. 6, June 2018, pp. 851 – 863.
- [24] H. Zhu, D. Liu, S. Zhang, S. Teng, and Y. Zhu, "Solving the Group Multi-Role Assignment Problem by Improving the ILOG Approach", *IEEE Trans. on Systems, Man, and Cybernetics: Systems*, vol. 47, no. 12, Dec. 2017, pp. 3418-3424.
- [25] H. Zhu, "Avoiding Conflicts by Group Role Assignment", *IEEE Trans. on Systems, Man, and Cybernetics: Systems*, vol. 46, no. 4, April 2016, pp. 535-547.
- [26] H. Zhu, M. Hou, C. Wang, and M.C. Zhou, "An Efficient Outpatient Scheduling Approach", *IEEE Trans. on Automation Science and Engineering*, vol. 9, no. 4, Oct. 2012, pp. 701-709.
- [27] H. Zhu, M.C. Zhou, and R. Alkins, "Group Role Assignment via a Kuhn-Munkres Algorithm-based Solution", *IEEE Trans. on Systems, Man, and Cybernetics, Part A: Systems and Humans*, vol. 42, no. 3, 2012, pp. 739-750.
- [28] H. Zhu, M. C. Zhou, and R. Alkins, "Group Role Assignment via a Kuhn-Munkres Algorithm-based Solution," *IEEE Trans. on Systems, Man and Cybernetics, Part A*, vol.42, no. 3, 2012, pp. 739-750.
- [29] H. Zhu and M.C. Zhou, "Role-Based Collaboration and its Kernel Mechanisms", *IEEE Trans. on Systems, Man and Cybernetics, Part C*, vol. 36, no. 4, pp. 578-589, July 2006.
- [30] H. Zhu, "The Role Mechanism in Collaborative Systems," *Int'l J. of Production Research*, vol. 44, no. 1, 2006, pp. 181-193.



Dr. Haibin Zhu is a Full Professor and the Coordinator of the Computer Science Program, the Founding Director of the Collaborative Systems Laboratory, Nipissing University, Canada. He is also an affiliate professor at Concordia University and an adjunct professor at Laurentian University, Canada. He received a B.S. degree in computer engineering and M.S. and Ph.D. degrees in computer science from the National University of Defense Technology, China.

He was the chair of the Department of Computer Science and Mathematics, Nipissing University, Canada (2019-2021). He has over 200 research publications including 30 more IEEE Transactions articles, six books and other publications.

He is serving as a member of the Board of Governors, co-chair of the technical committee of *Distributed Intelligent Systems*, and the *Electronic Communications Subcommittee of IEEE Systems, Man and Cybernetics (SMC) Society*, the Editor-in-Chief of IEEE SMC Magazine, an Associate Editor (AE) of *IEEE Transactions on SMC: Systems*, *IEEE Transactions on Computational Social Systems*. In addition to many other duties, he also served as a PC member for more than a hundred academic conferences.

His research interests include Collaboration Systems, Complex Systems, Human-Machine Systems, Computational Social Simulation, Collective Intelligence, Multi-Agent Systems, Software Engineering, and Distributed Intelligent Systems.