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Lefei Li · Fei-Yue Wang

Parallel Services

Intelligent Systems of Digital Twins and Metaverses for Services Science

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Preface

Starting from the beginning of this century, service science/engineering has been a standalone and fast-emerging discipline that declares the dominance of service economy.

Traditionally, the complexity of any service system comes from the nature of service: simultaneity, intangibility, heterogeneity, and perishability. Nowadays, however, the rapid adoption of technologies, especially ICT, makes information go beyond just one aspect of a service system, but a major, and even the dominant one. AI, big data, cloud computing, blockchain, VR/AR, etc. make the design and management of service systems far more challenging and far more fascinating than ever in the history of mankind.

Parallel intelligence, evolving from parallel control and management, has been recognized as a promising methodology for the modeling and analysis of complex systems, especially for complex CPSS (Cyber-Physical-Social Systems). Based on years of studies of parallel intelligence and its applications in various service industries, we establish a new approach for service system: parallel service.

The theoretical foundation of parallel service lies in the actual-artificial duality of services, which comes from the Karl Popper's model of reality and corresponding three axial ages. With the ability to model service systems as artificial service systems, perform computational experiments and parallel learning. Parallel service becomes the bridge that connects the "Cognitive Gap" between the actual and artificial world. The enabling technologies, including decentralized technology, multiagent simulation, and data fusion, etc., provide a handful "toolbox" that supports the realization of parallel service.

In the application studies that cover various typical service industries like transportation, retailing, healthcare, etc., parallel service demonstrates three unique advantages: interdisciplinary integration, smarter service decision making, and enabling human-centered service innovations.

In recent years, along with the trend of digital transformation, digital twin and meta-verse appear to be the next "engine" Parallel service naturally serves as an enabling mechanism for digital twin and metaverse in service systems. Our true DAO model in parallel service explains the unique power toward that direction.

The target of this book is to provide the readers a new way of thinking of a service system. For academic readers, it provides a new research area within the service science/engineering domain, incorporating vast of interdisciplinary advancements. For practitioners, with the help of dedicated methods and sample cases, the book shall provide opportunities to enhance the design and management of all types of modern service systems.

Beijing, China
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Acknowledgments

For many years, we have been conducting research on parallel intelligence and applying the concept to various service industries. In this book, we build on our past research to develop a new approach to services systems: Parallel Services.

Parts of Chaps. 3 and 7 on parallel intelligence have been published in our other papers. The parallel services framework in Chap. 4 was published as a PSM concept in my paper "Parallel Service Management Framework and Application to Railway Station Layout Planning" in IEEE Intelligent Systems.

The authors would like to acknowledge all those who participated in the process of compiling and reviewing this book for their help, without which this project could not have been successfully completed. And this work was supported by my students. They are Tsinghua University PhD students Ridong Wang, Yudan Lu, Yuchen Liang, and master's student Zibing Zhan. They contributed throughout the process from the initial idea to the final publication. In addition, this work was supported by the National Key R&D Program of China under Grant No. 2020AAA0103804.