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SPATIAL NETWORKING IN THE UNITED PHYSICAL, VIRTUAL, AND MENTAL WORLD

(New book summary)

ПРОСТОРОВІ МЕРЕЖІ В ОБ'ЄДНАНОМУ ФІЗИЧНОМУ, ВІРТУАЛЬНОМУ ТА МЕНТАЛЬНОМУ СВІТІ

(Короткий зміст нової книги)

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Анотація. Ми спостерігаємо стрімке зростання популярності та активності використання мережевих моделей і рішень для вирішення проблем у багатьох конкретних сферах. Мережу як універсальний засіб можна використовувати для вирішення складних задач і водночас для охоплення абсолютно різних сфер. Основна мета цієї книги полягає в тому, щоб дослідити та запропонувати універсальні мережеві методи та рішення, які можуть одночасно охоплювати різні сфери, для пошуку єдиних рішень, використовуючи для цього запатентовані Модель та Технологію просторового захоплення (ТПЗ), що описуються в попередніх книгах та публікаціях. У книзі розглядатиметься, аналізуватиметься і класифікуватиметься сучасний стан використання мереж у багатьох фізичних, віртуальних та розумових сферах, включаючи психологічні та психіатричні. У ній подаватиметься короткий опис ТПЗ та її основних функцій, розкриватимуться деталі Мови просторового захоплення (МПЗ) та її мережевої реалізації, яка може відбуватися без будь-яких центральних ресурсів та охоплювати довільно великі сфери. У роботі описуватимуться деякі фундаментальні мережеві операції, які здійснюються за допомогою ТПЗ і можуть відбуватися в паралельному та повністю розподіленому режимі, а також запропонуються ефективні рішення для однієї з найважливіших особливостей графів і мереж – «центральністю» та її різними варіантами у МПЗ. Буде представлено кілька прикладів унікальних високорівневих мережевих рішень у комбінованих світах, отриманих за результатами цієї книги, і запропоновано просторові рішення з активними мережевими патернами як у режимах їх зіставлення, так і розпізнавання, представляючи МПЗ як справжню мову патернів. Результати роботи підтвердять ефективність використання ТПЗ для розробки мережевих методів розв'язання складних задач у комбінованих розподілених системах. Досліджувана парадигма мережевої обробки, яка традиційно має просту реалізацію, дозволяє діяти безпосередньо у фізичному, віртуальному та розумовому просторах у зрозумілому та «компактному» режимі, таким чином радикально відрізняючись від традиційного алгоритмічного мислення та методів. Посилання: «Spatial Grasp» на www.google.com, Research Gate: https://www.researchgate.net/scientific-contributions/ Peter-Simon-Sapaty-70005622.

Abstract. We are witnessing the rapidly growing popularity and activity in the use of networking models and solutions for solving problems in many specific areas. As a universal approach, networking can also be used for solving complex problems and simultaneously covering absolutely different domains. The main goal of this book is to investigate and propose universal networking techniques and solutions that can simultaneously cover different areas for finding united solutions, using for this Spatial Grasp Model and Technology (SGT) patented and discussed in previous books and publications. The book will review, analyze, and classify the current use of networks in many physical, virtual, and mental areas, including psychological and psychiatric ones. It will provide a summary of SGT and its main features, the details of

Spatial Grasp Language (SGL), and its networked implementation, which can operate without any central resources and cover arbitrarily large areas. The work will also describe some fundamental network operations under SGT that can be performed in a parallel and fully distributed mode, as well as propose efficient solutions for one of the most important features of graphs and networks called "centrality" and its different variants in SGL. It will provide some examples of unique high-level networking solutions in the combined worlds obtained by the results of this book and suggest spatial solutions with active networking patterns in both pattern matching and recognition modes, representing SGL as a real pattern language. The results of the work will confirm the efficiency of SGT in the development of networking methods for solving complex problems in combined distributed systems. The investigated network processing paradigm, traditionally having a simple implementation, allows us to operate directly in physical, virtual, and mental spaces in a clear and compact mode, radically differing from traditional algorithmic thinking and methods. Refs: «Spatial Grasp» on www.google.com, Research Gate:
https://www.researchgate.net/scientific-contributions/Peter-Simon-Sapaty-70005622.

Chapter 1: Introduction

There is a rapidly growing popularity of the use of networking models and solutions for solving problems in specific areas. As a universal approach, networking can be potentially used in a much broader sense for solving complex problems simultaneously covering physical, virtual, and mental (psychological) domains. The main goal of this book is to investigate and propose extended networking techniques that could simultaneously cover different areas for important united solutions, using Spatial Grasp Model and Technology patented and revealed in previous books and publications. This chapter will include a summary of the following chapters, together with references to existing publications in similar fields.

Chapter 2: The use of networks in physical, virtual, and mental domains

It reviews, analyzes, and classifies existing publications on the use of networks in different areas like traffic networks, battle networks, economic networks, virtual networks, and psychological networks, where the latter have emerged as a very popular method for studying mental diseases. For example, psychopathology networks consist of symptoms of mental disorders (nodes) and the connections between those aspects (edges). Some works on network centrality issues for finding the most important nodes that can influence the behavior and value of the whole network are investigated too, covering centrality in social networks, centrality in transport and underground networks, and centrality in psychological networks.

Chapter 3: Spatial Grasp Technology (SGT) and its main features

Having more than a half-century history and experience in distributed computer networking, this recursive super-virus model and technology, which is self-evolving, self-migrating, and self-matching in distributed environments (as symbolically shown in Fig. 1), will be briefed and explained, including its used applications in different areas and countries. It can dynamically establish and maintain superior vision and power over any centralized and distributed systems while being fully independent of their organizations and networked structures, but rather creating, supervising, and modifying them if needed.

Figure 1 – Parallel wave-like world coverage with Spatial Grasp Model

Chapter 4: Spatial Grasp Language (SGL)

It provides details of Spatial Grasp Language which may be particularly useful for proper understanding of practical examples in the subsequent chapters. The chapter describes different types of SGL constants and variables with their semantics, spatial distribution, and movement, it also provides a full repertoire of SGL rules with their semantics and practical use, which include type, usage, movement, creation, echoing, verification, assignment, advancement, branching, transference, exchange, timing, qualification, and grasping. Some elementary examples of programming in SGL are provided too, along with its full syntax and most commonly used constructs.

Chapter 5: Networked SGL implementation

Explains how SGT can be implemented with communicating SGL interpreter copies potentially numbering millions to billions, which can be easily embedded into any existing systems, including Internet, representing altogether powerful spatial engines capable of solving any problems in terrestrial and celestial environments. As both the backbone and nerve system of the distributed interpreter, its self-optimizing Spatial Track System supports hierarchical command and control as well as remote data and code access. It also supervises spatial variables and merges distributed control states used for decisions at higher organizational levels. Distributed SGL interpretation networks can effectively operate without any central control.

Chapter 6: Basic network operations in different worlds under SGT

It presents some detailed solutions for network creation, network modification, network recovery, finding different paths, the shortest path trees and shortest paths, cliques, articulation points, etc., as well as proper graph images. The chapter shows how to support network integrity, provide global network awareness, collect network statistics, find and collect proper network parts, and create similar ones in other spaces. The investigated networks can be physical, virtual, or combined, having both addresses and physical coordinates, and hierarchical. Links may have any weight, and both links and nodes may have any additional content. The created networks can be active, they can exist as autonomous systems that are self-evolving in space. All presented network solutions are fully distributed and parallel, with networks potentially covering any terrestrial and celestial areas.

Chapter 7: Expressing and solving network centrality solutions in SGL

It investigates, evaluates, and models one of the most important features of graphs and networks called Centrality, with such its variants as Degree Centrality, Closeness Centrality, Betweenness Centrality, and Eigen Vector Centrality. Detailed, very efficient, and extremely compact SGL scenarios for solving these centrality problems on the chosen network topology are provided and discussed, being highly parallel and fully distributed. They can operate on arbitrary complex and large networks, which can evolve in time and space and cover whole countries or even the universe, without any centralized resources, taking into account the practical availability of networked SGT implementation in any distributed environment.

Chapter 8: Examples of holistic networking solutions in the combined worlds

Some practical cases will be investigated with the integration of different types of networks into a super-network operating as an integral whole under SGT and capable of providing solutions unachievable by separate networks or their mere collection. This will include the following: 1) physical network, reflecting transport, economic, and/or military networks; 2) virtual network, representing distributed and interlinked information, which may have common nodes with 1; 3)

social network, matching the organization of a society, may have common nodes with 1, 2; 4) mental, psychological, or psychiatric network, revealing moral problems, feelings, and opinions, with nodes and links in the brains of individuals or between them, as well as noticed and fixed symptoms of their behavior (may intersect with 1, 2, and 3).

Chapter 9: Active spatial patterns in SGL versus traditional algorithms

Pattern is everything around us; it can represent the world's regularity, human-made design, a model, plan, or diagram, a standard way of modeling, acting, and thinking, a distinctive style or form, a combination of qualities and tendencies, etc. The chapter will investigate how SGL can create active networking patterns for solving diverse problems with practical solutions for spatial pattern recognition and pattern matching in distributed networks, SGT, based on pattern-like scenarios that can be considered a contribution to patterns theory, and SGL as a real pattern language. This spatial pattern style radically differs, both mentally and mathematically, from the traditional meaning of algorithm as a finite sequence of instructions for solving specific problems or performing computation.

Chapter 10: Conclusions

The results of this book confirm the efficiency of SGT in the development of networking methods for solving complex problems within combined distributed systems. The paradigm allows us to move and operate directly in physical, virtual, and mental spaces in a clear and compact mode, radically differing from traditional algorithmic thinking. It symbolically creates holistic networking «creatures» that are self-evolving, self-propagating, and self-matching in the distributed worlds. The latest version of SGL can be implemented by a group of system programmers, even in university environments, as it was done for the previous versions in different countries. The plans for this work include the application of SGT and SGL for extended network-based systems, including in psychology and psychiatry.

REFERENCES

They contain information on many publications describing the use of networking models and approaches in different areas which are analyzed and classified in the book chapters, as well as published basic sources on SGT and SGL.

Other books that were analyzed, compared, and used for this book

The following books were analyzed in detail to see how they may relate to the current book proposal. The results of this analysis confirm that the suggested advanced networking methods and their supporting technology of the current book, especially allowing for holistic integration of physical, virtual, and psychological domains, can be useful for solving the mentioned and extended problems practically for every book referenced. The final (N 16) book described previous results obtained on SGT and SGL, and the proposed book is planned to be its direct sequel.

1. Wright D.L.S. The Physical and Virtual Space of the Consulting Room: Room-object Spaces. Routledge, 2022. – It examines the role of space and objects in the psychoanalytic process and explores spatialization as simultaneously being a psychological projection of meaning and physically acting upon the environment.
2. Weiss P.L., Keshner E.A., Levin M.F. Virtual Reality for Physical and Motor Rehabilitation (Virtual Reality Technologies for Health and Clinical Applications). Springer, 2014. – It reviews two decades of progress in virtual reality for physical and motor rehabilitation and offers research on the capacity of VR to evaluate, address, and reduce motor skill limitations.

3. Friedman P. The Pilates Method of Physical and Mental Conditioning. Doubleday, 1984. – A unique system of physical and mental exercise that stresses control and centering of the body, precise movement, smoothness of motion, proper breathing, and relaxation.

4. Wixted B. Innovation System Frontiers: Cluster Networks and Global Value (Advances in Spatial Science). Springer, 2009. – Using interdependencies between key economies, it analyses systems that cross national borders and shows that technological complexity is an important factor in the formation of production networks.

5. Morsink R.L.A. Foreign Direct Investment and Corporate Networking: A Framework for Spatial Analysis of Investment Conditions. Edward Elgar Publishing. – It examines foreign direct investment from a spatial perspective and considers how knowledge, regional synergies, economic integration, corporate strategies, and networking affect patterns of investment.

6. Bai L., Liang X., Jin R., Yu. Q. Spatial Multidimensional Cooperative Transmission Theories and Key Technologies. World Scientific, 2020. – It introduces the theory and technologies of multi-antenna system and describes spatial multi-dimensional cooperative transmission in the ground-, air-, and space-based communication systems.

7. Yang K.S., Shekhar S. Spatial Network Big Databases: Queries and Storage Methods. Springer, 2017. – It provides a collection of concepts, algorithms, and techniques that effectively harness the power of spatial network big data and investigates scalable graph-based query processing strategies.

8. Franke M. Managing Airline Networks: Design, Integration, and Innovative Technologies (Managing Aviation Operations). Routledge, 2020. – It discusses the impact of network management on airline resource planning and performance and examines the interplay between network management and adjacent functions.

9. Wu Q., Shen F., Liu Z., Jiao W. Optimal Operation of Active Distribution Networks: Congestion Management, Voltage Control and Service Restoration. Academic Press, 2023. – It provides case studies, modern implementations, and supporting flowcharts and code, along with current research in congestion management, service restoration, and voltage control of active distribution networks.

10. Isvoranu A.-M., Epskamp S., Waldorp L., Borsboom D. Network Psychometrics with R: A Guide for Behavioral and Social Scientists. Routledge, 2022. – It provides a comprehensive overview and guide to theoretical foundations of network psychometrics, infers network topology, and estimates network parameters from different sources of data.

11. Meghanathan N. Centrality Metrics for Complex Network Analysis: Emerging Research and Opportunities (Advances in Wireless Technologies and Telecommunication). IGI Global, 2018. – Research findings on centrality metrics and their broader applications for different categories of networks, including wireless sensor networks, curriculum networks, social networks, etc.

12. Lange A. Centrality in Strategic Transportation Network Design: An application to less-than-truckload networks (Edition KWV). Springer Gabler, 2019. – It describes the appearance of a network by considering transportation network centrality and develops a strategic approach to transportation network design by conceptualizing transportation network centrality.

13. Morselli C. Crime and Networks (Criminology and Justice Studies). Routledge, 2013. – It showcases the use of social networks in the analysis and understanding of various forms of crime and applies to criminology many conceptual and methodological options from social network analysis.

14. Read J., Bentall R., Mosher L., Dillon J. Models of Madness: Psychological, Social and Biological Approaches to Psychosis (The International Society for Psychological and Social Approaches to Psychosis Book Series). Routledge, 2013. – It challenges the beliefs that madness can be explained without reference to social causes and updates the research showing that hallucinations, delusions, etc. are best understood as reactions to adverse life events.

15. Diwadkar V.A., Eickhoff S. B. Brain Network Dysfunction in Neuropsychiatric Illness: Methods, Applications, and Implications. Springer, 2021. – It provides a synthesis of the uses of multiple analytic methods applied to neuroimaging data to seek understanding of the neurobiological bases of psychiatric illnesses.
16. Sapaty P.S. Symbiosis of Real and Simulated Worlds under Spatial Grasp Technology (Studies in Systems, Decision and Control Book 354). Springer, 2021. – It investigates new important applications of Spatial Grasp Technology allowing it to effectively simulate and manage large distributed dynamic systems on semantic and holistic levels.

This book is a sequel to the following patent and previous books

1. Sapaty P.S. A distributed processing system, European Patent N 0389655, Publ. 10.11.93, European Patent Office.
2. Sapaty P.S. Mobile Processing in Distributed and Open Environments. New York: John Wiley & Sons, 1999. 410 p.
3. Sapaty P.S. Ruling Distributed Dynamic Worlds. New York: John Wiley & Sons, 2005. 256 p.
4. Sapaty P.S. Managing Distributed Dynamic Systems with Spatial Grasp Technology. Springer, 2017. 301 p.
5. Sapaty P.S. Holistic Analysis and Management of Distributed Social Systems. Springer, 2018. 249 p.
6. Sapaty P.S. Complexity in International Security: A Holistic Spatial Approach. Emerald Publishing, 2019. 219 p.
7. Sapaty P.S. Symbiosis of Real and Simulated Worlds under Spatial Grasp Technology. Springer, 2021. 230 p.
8. Sapaty P.S. Spatial Grasp as a Model for Space-based Control and Management Systems. CRC Press, 2022. 186 p.
9. Sapaty P.S. The Spatial Grasp Model: Applications and Investigations of Distributed Dynamic Worlds. Emerald Publishing, 2023. 184 p.

The latest journal papers that relate to this new book

1. Sapaty P.S. Spatial management of air and missile defense operations. *Mathematical machines and systems*. 2023. N 1. P. 30–49.
2. Sapaty P.S. Providing distributed system integrity under spatial grasp technology (contents of the new book). *Mathematical machines and systems*. 2023. N 2. P. 130–134.
3. Sapaty P.S. Providing Global Awareness in Distributed Dynamic Systems. *International Relations and Diplomacy*. 2023. Vol. 11, N 2. P. 87–100. DOI: 10.17265/2328-2134/2023.02.002.
4. Sapaty P.S. Simulating distributed consciousness with Spatial Grasp Model. *Mathematical machines and systems*. 2023. N 3. P. 13–30.