对美国出版的第一本“网络科学”专著的评论

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按语：

今年 4 月 27 日我收到美国信息科学协会杂志(JASIST)负责书评的副主编 Lokman I. Meho 博士的邀请函，请我为在 WILEY 出版社 2009 年 3 月出版的一本 TED G LEWI 的专著：“网络科学—理论与应用”（“NETWORK SCIENCE— Theory and Applications”）撰写一篇评论。我接受了他们的邀请，随后收到赠寄的这本英文原著。可能由于我及其合作者 2007 年在我国“物理学进展”发表了“一门崭新的交叉科学— 网络科学（上，下）”长篇综述文(该文 2008 年获得“第六届中国科协期刊优秀学术论文二等奖”)，并在 2008 年出版了编著：“驾驭强流束晕与探索网络科学”等，多少已经引起了国内外的关注，所以给我这个殊荣，特邀我来评论一下美国出版的第一本“网络科学”专著。我感到责任大，而我的英文并不好，这对我也是一个挑战。经过努力，我终于写出了简要评论。为了谨慎起见，特请我的朋友香港城市大学的讲座教授陈关荣过目修饰，现在这个评论稿在这里先与网友见面了，我准备在这里留二天时间请大家，特别是同行和英文好的朋友给于指正，提出宝贵的修改意见，反馈给我，然后我再作进一步的修定。如能如愿，将不尽感谢。

网络科学正在国内外继续深入发展，我国在这方面的研究也有很好的工作，与国外同步进展。就在这本“网络科学”专著中引用了我国汪小帆和陈关荣合作的三篇文章也是一个例证。网络科学的理论方法研究成为最广泛的交叉科学的一种强有力的思想武器。今年 7 月 24 日出版的《科学》杂志刊登专题——《复杂系统与网络》（Complex Systems and Networks），充分表明网络科学在国际上仍然强劲地进一步向众多学科的深入研究和向应用发展。在这个《复杂系统与网络》专题的导言《关联》（Connections）开篇中引用丁•路德•金的名言：**“我们被困在无法逃避的相互关系网络中，任何事情，如果直接地影响了一个人，就会间接地影响所有人。”** 从网络科学的视角来看，自然界和人类社会里，网络无处不在，正在深刻而广泛的影响着我们的日常生活和科学技术等各种的活动。因此利用网络科学可以探讨

自然界和人类社会的各种各样的复杂系统。网络科学正在与众多新兴科学（如混沌科学等），相互交融和推动，又一次提供了一种新的科学发展观和方法论，使决定论与随机性、有序性与无序性、复杂性与简单性，又一次达到了和谐的统一，人类的认识产生了一次新的飞跃，成为人们认识客观世界的有力武器。在网络科学的思想、理论与方法的大框架下，无论从微观层次，还是宏观和宇观层面，人们都可从网络的新角度、新观点和新方法来探讨 21 世纪关注的世界万物的复杂性问题。

下面是我写的英文评论稿，现在这个稿参考文献又增加了我国出版的有关

复杂网络(科学)方面的著作,请各位网友、博友和同行专家多提意见和建议。

A Brief Review of “Network Science—Theory and Application”

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As far as I know, the emerging field of network science has just begun after 1998 [1]. And a few books and review articles or special reports named after “Network Science” has been published worldwide [1-8]. The words “Network Science” or “New Science of Networks” firstly appeared in the United States [2-5], followed by China [6-12] and others. However, “Network Science” was already used by Professor Ted G. Lewis for his book, published by Wiley, which was perhaps the first comprehensive and representative book on Network Science published in the United States. Although a common feature of this kind of books is the theory and methodology from Network Science and their extensive applications to various interdisciplinary areas, each book has its unique viewpoints and distinguishing features. Here, I would like to provide my personal review on the remarkable merits of this book, which deserve special attention.

Firstly, the contents of the book have thirteen chapters which include key issues with exercises except for the first chapter. The first chapter describes the history timeline of significant events of network science development, from graph theory particularly random graphs, to modern network theory and its applications, which is the most complete description

about the network history that I know. I agree that the history of network science has three milestones, corresponding to three time periods, as the book shows.

Secondly, there is an abstract-like introduction to summarize and point out the most important part of each chapter. The first half of this book traces the development of network science along a trail blazed by the pioneers and inventors. This makes readers easily understand the objectives.

Thirdly, the book describes each issue (chapter) of network science through the use of illustrations, tables, practical problems with solutions, case studies, and applications to related Java software (there are 5 major Java applications for demonstration), where the latter is quite different from all the other books. The first 6 chapters develop the field from its graph-theory root to the modern definition of a network. These chapters are devoted to the most well-known classes: regular, random, small-world, and scale-free networks. All materials in the contents are adequately described and presented.

Fourthly, Chapter 7 about “Emergence” is a concept with extensive and profound meanings about complex systems and networks. And searching for emergence has been one of the very important and interesting issues for complex network theory and interdisciplinary science. What is emergence and what is network emergence? This is one significant subject and phenomenon arising from complex systems and networks. The book gives a definition of network emergence, which is more than a network’s transformation from an initial state to the final state. In physical and biological sciences, emergence is a concept of some new phenomena arising from a system that were not in the system’s specification to start with. This book’s definition refers to the repeated application of microrules that result in an unexpected macrostructure that hints a key point. The book gives a brief explanation and is easy to understand. And it introduces new self-organizing principles for networks, and shows how to custom-design networks with an arbitrary degree sequence distribution. That may help people design faster, more resilient communication networks and revise some associated networks.

Fifthly, the second half of this book, from Chapter 8 to Chapter 13, briefly describes several important issues, from a practical application point of view, with further studies. Chapter 8, “Epidemics,” may excite new endeavor of designing antigen countermeasures for the Internet, and can be used to explain human epidemics as well as epidemics that sweep across the Internet. Chapter 9, “Synchrony,” is an issue that has received a great deal of attention in the studies of complex networks in the past, but the book only gives a brief description. Chapter 10, “Influence networks,” proposes what conditions must be met in order for a social network to

come to consensus. Chapter 11, “Vulnerability,” shows how network might be attacked, which may be used on a daily basis to valuate critical infrastructure and protect them against natural and synthetic attacks. Chapter 12, “Netgain,” is an exploration of a business model, and introduces some classical market models as reference. Chapter 13, “Biology,” introduces the reader to the exciting new field of protein-expression networks and suggests some new directions for the reader to consider. It emphasizes both of static and dynamical analysis as well as the relationship of dynamics with structure and function, where the latter is the most fascinating application of network science today.

As mentioned in the Preface, “This book is a start, but it also leaves many questions unanswered.” Yes, some important issues have not been addressed by it, such as information networks, swarm aggregation or flocking of multiple agents, weighted nonlinear evolution networks, social networks, network centric warfare, and so on.

However, I believe that researchers, professionals and technicians in engineering, computer science, and biology will benefit from this book with an overview of new concepts in network science. And it will inspire a new generation of investigators and researchers.

In summary, the book is a valuable reference with practicability especially for engineering and graduate students, although some more theoretical subjects or deep-level problems could be involved to strengthen and improve its quality and presentation.

Finally, I may mention that the cover of the book is “Network Science: Theory and Application” but it is changed to “Network Science: Theory and Practice” on the opening page. Why is that? A correction may be needed.

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