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Network science research: some recent progress in China and beyond

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Modern network science may be traced back to Euler when he solved the interesting Königsberg seven-bridge problem in 1736, thereby laid down a mathematical foundation of the graph theory [1]. The now-classic random graph theory was established by Erdös–Rényi in the late 1950s [2]. About a decade ago, the new concept of small-world networks was outlined by Watts–Strogatz [3], followed by Barabási–Albert's scale-free network model published [4]. These recent works have stimulated a great deal of interest and effort in pursuing a comprehensive scientific theory of complex networks and its applications, encompassing both natural and artificial networks of all kinds. This is especially significant in the present era of big data. As a matter of fact, network science and engineering has become a rapidly developing research paradigm in the realm of modern science and technology today.

The study of network science aims at investigating large-sized (with many vertices and edges) and higher-dimensional networks (vertices are higher-dimensional dynamical systems, edges have many state components or communication channels), connected in stochastic or irregular structures (random-graph, small-world, scale-free topologies), with non-linear and time-varying couplings and in evolutionary processes (growing, evolving, impulsive, time-delayed manners), and even in a wide range of spatio temporal scales. Under such extremely complicated networking conditions, especially under the intrinsic 'network of networks' framework, the questions as 'what and how the conventional mathematical graph theory, computer science theory and control systems theory should do and can do' offer a unique opportunity for greater science and technology developments, which also post many difficult theoretical as well as practical challenges to both scientific research and technological developments.

Chinese researchers had already stepped into this exciting field. In retrospect, the new trend of network science studies was recognized and followed up quite quickly in China: the subject was being identified and studied in year 2000, with the first set of research papers submitted in 2001 and published in January 2002 [5,6]. To date, there have been 10 Chinese conferences on complex networks and 10 Chinese complex networks forums held in China, both initiated in 2003. Moreover, a Chinese book series on network science and engineering has been in place since 2010 (e.g. [1]).

To reflect the state-of-the-art research progress in the field of network science in China and beyond, this special section of the *National Science Review* presents several timely technical reviews and perspectives, along with a highlight and an interview, on some closely related subjects, pointing to some new research directions in the field.

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REFERENCES

1. Chen, G, Wang, X and Li, X. *Introduction to Complex Networks: Models, Structures and Dynamics*. Beijing: Higher Education Press, 2012; *Fundamentals of Complex Networks*, 2nd edn. Singapore: Wiley, 2014.
2. Erdös, P and Rényi, A. *Publ Math Inst Hung Acad Sci* 1960; **5**: 17–60.
3. Watts, DJ and Strogatz, SH. *Nature* 1998; **393**: 440–2.
4. Barabási, AL and Albert, R. *Science* 1999; **286**: 509–12.
5. Wang, X and Chen, G. *Int J Bifurc Chaos* 2002; **12**: 187–92.
6. Wang, X and Chen, G. *IEEE Trans Circuits Syst-I* 2002; **49**: 54–62.