Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **13 (2006)** 463-469

TRAFFIC DYNAMICS ON COMPLEX NETWORKS

Tao Zhou[1,2], Gang Yan[2], Bing-Hong Wang[1,*], Zhong-Qian Fu[2], Bo Hu[1], Chen-Ping Zhu[3] and Wen-Xu Wang[1]

[1]Nonlinear Science Center and Department of Modern Physics
University of Science and Technology of China, Hefei Anhui, 230026, P. R. China

[2]Department of Electronic Science and Technology
University of Science and Technology of China, Hefei Anhui, 230026, P. R. China

[3]Department of Applied Physics, Nanjing University of Aeronautics and Astronautics
Nanjing Jiangsu, 210016, P. R. China

Abstract. In this paper, we propose a simple model for traffic dynamics on networks. For both homogeneous and heterogeneous networks, there exists a phase transition from free phase to congested phase. The value of the transition point can be considered as a measure of network's communication ability, which is significantly affected by the topology of the network. It scales as $\sqrt{N}$ in a square lattice, while varies slightly with N in scale-free network when N is not very large, where N denotes the number of nodes. The simulation results agree with the theoretical estimation qualitatively.

Keywords. complex network, traffic dynamics, scale-free network, communication ability, betweenness

AMS (MOS) subject classification: 05C90, 94A99

1 Introduction

Many social, biological and communication systems can be properly described as complex networks with nodes representing individuals or organizations and edges mimicking the interactions among them [1-3]. One of the ultimate goals of the current studies on topological structures of networks is to understand and explain the working mechanism of systems built upon those networks: for instance, to understand how the topology of the Internet affects the spread of computer viruses [4-6], how the structure of power grids or traffic networks affects the cascading behavior [7-9], how the connecting pattern of the World Wide Web affects Web surfing and search engines [10-11], and so on.

We focus on the traffic dynamics on complex networks, which can be applied everywhere, especially the vehicle flow problems on networks of roads and the information flow dynamics on interconnected computer networks.

There have been previous studies on understanding and controlling traffic congestions on networks, with a basic assumption that the network has a

[1]* Corresponding author, email: bhwang@ustc.edu.cn