COMMUNICATIONS IN COMPUTATIONAL PHYSICS
Vol. **5**, No. 5, pp. 1045-1053

Commun. Comput. Phys.
May 2009

Continuous Opinion Dynamics in Complex Networks

L. Guo* and X. Cai

Complexity Science Center and Institute of Particle Physics, Huazhong (Central China) Normal University, Wuhan 430079, China.

Received 12 July 2008; Accepted (in revised version) 3 September 2008

Communicated by Dietrich Stauffer

Available online 30 October 2008

Abstract. Many realistic social networks share some universal characteristic properties, such as the small-world effects and the heterogeneous distribution of connectivity degree, which affect the dynamics in society system, especially the opinion dynamics in society. To see this, we study the opinion dynamics of the Improved Deffuant Model (IDM) in complex networks. When the two opinions differ by less than the confidence parameter ϵ ($0<\epsilon<1$), each opinion moves partly in the direction of the other with the convergence parameter μ, which is a function of the opposite's degree k; otherwise, the two refuse to discuss and no opinion is changed. We analyze the evolution of the steady opinion s_* as a function of the confidence parameter ϵ, the relation between the minority steady opinion s_*^{min} and the individual connectivity k, and find some interesting results that show the dependence of the opinion dynamics on the confidence parameter and on the system topology. This study provides a new perspective and tools to understand the effects of complex system topology on opinion dynamics.

PACS: 05.45.-a, 87.23.Ge, 89.75.-k

Key words: Opinion dynamics, complex networks, bifurcation phenomena.

1 Introduction

Our local society, which can be well modelled as complex network, has its own structure depending on the geography, culture and history. Recently it has also been realized that many real social networks arising in society, such as networks of sexual relationships [1], collaborations between actors [2, 3] and scientists [4, 5], web-based social networks [6], P2P social network [7], and the BBS networks [8] all share some universal characteristics such as the small-world effect and the power-law degree distribution. Those features

*Corresponding author. *Email addresses:* longkuo0314@gmail.com (L. Guo), xcai@mail.ccnu.edu.cn (X. Cai)

affect the dynamics in society systems, especially the opinion dynamics in complex network. Many natural and man-made networks have been successfully studied as a framework of several celebrated opinion models. Some relevant results have been summarized in a recent review article by Toral and Tessone [9]. Nevertheless, the understanding of the opinion dynamics in complex networks remains a challenge.

Social impact theory founded by Latané [10, 11], was developed as a metatheoretical framework for modelling situations where beliefs, attributes or behaviors of an individual are influenced by those of others around him/her. Based on the social impact theory, there are two celebrated opinion models proposed in recent years. One celebrated model is the binary opinion model that is proposed by K. Sznajd-Weron and J. Sznajd (S model) [12] to describe a simple mechanism of making up decisions in a closed community. In this model, the opinion of individual is a binary variable assuming the value +1 and -1 that referring to two opposite opinions on a particular issue. The updating rules follow the principle of "united we stand, divided we fall". The other is the continuous model proposed by Deffuant et al (D model) [13]. In D model, the opinion s of individual varies continuously between zero and one. Each agent selects randomly one of the other agents and checks first if an exchange of opinions makes sense. If the two opinions differ by less than ϵ $(0<\epsilon<1)$, each opinion moves partly in the direction of the other, by amount $\mu\Delta s$, where Δs is the opinion difference and μ the convergence parameter $(0<\mu\leq 0.5)$; otherwise, the two refuse to discuss and no opinion is changed. The parameter ϵ is called confidence bound or confidence parameter. In a society, people typically have continuous opinions and always change their opinions due to the influence of acquaintances or other external factors.

Since the D model was introduced, the model has been paid much attention [14, 15]. Many previous works about D model have considered the convergence parameters μ between pairwise agents are uniform on regular lattices and complex networks [13, 16–18]. For instance, G. Weisbuch [18] had studied the D model on regular lattice and scale-free network and discussed the influence of possible social networks topologies in the opinion dynamics of D model. Furthermore, D. Stauffer et al. [19] studied the discrete opinion dynamics of D model on scale-free network with single layer and multi-layer and introduced noise and advertising. They found that the simulation of the D model with discrete opinion could be simplified and made less ambiguous. And, noise and a more realistic network with stronger clustering do not change the results much in the discrete model. An ageing model with several layers representing different age groups gave results not much different from those of one single layer, also if advertising is included. On the other hand, our society is not the homogeneous one, i.e., each individual has his/her confidence parameter ϵ and convergence parameter μ (i.e., the influence of individual). G. Deffuant et al. [20] studied the opinion dynamics of D model with different confidence parameter and analyzed the role of the extremists and got many fruitful results. However, in our society, we often change our opinion as the one of individual who is a famous expert about the particular issue according to the celebrity effect. In our present work, we assume that the larger the agent's connectivity is, the more famous