A Review on Social Opinion Dynamics Models

[1]Rohini Ashok Pandit, [2]Dr. Gulve Avinash Khushal, [3]Dr. Praveen Shetiye

Computer Science & Engineering
Government College of Engineering, Aurangabad, India

***Abstract*: This is study of prediction of opinions and understanding of the dynamics of opinions. In recent years people uses social networking sites and Social platforms to express their opinions. Internet users spend their time on discussion of the sporting events, latest news, political issues, and new products. These results into a growing interest of use social networking sites, social networks for reorganization and prediction of opinions, as well as to understand the dynamics of opinions. So far, lots of researches have been carried out on opinion dynamics. To provide a clear perspective on the opinion dynamics, this paper presents a review on opinion dynamics models along with its applications.**

***Index Terms*: Opinion dynamics, social network, DeGroot model, Vector model.**

I. INTRODUCTION

In a social network, humans are considered as basic elements, and their behavior depends on many variables. The important factors behind their behavior are opinions. In recent part, lot of literature has been developed about online voting. While online voting is an important part of research in recent years, efforts to develop solutions in the real world have just begun to create new challenges. Among the available dataset, voting results data is popular.

The opinion dynamics is the study of the opinion fusion process through interactions among a group of agents. Opinion dynamics research originated in France [14], and some opinion dynamics models have been proposed, listed as voter model, DeGroot model, Friedkin and Johnsen model, Sznajd model, voter model, continuous opinions and discrete actions model, majority rule model, bounded confidence model. An opinion dynamic model consists of opinion expression formats, fusion rules, and opinion dynamics environments. Opinion dynamic model is the change of the faith of an agent under social pressure. According to the different opinion formats, the models of opinion dynamics are divided into two types: discrete opinion and continuous opinion models.

II. RELATED WORK

With the increase in use of social networks many social interactions happen online to express themselves, their opinions and likings. In 2014 work done on dynamics estimation of individual opinions by Armin Ashoui Rad et al. [2]. The aim is to provide an automated method for extracting user opinions in online communities based on their interact on pattern. They use that method to estimate the online opinion changes, and show how individual opinions change as a result of exposure to stories not too far from them. They estimated the underlying decision rules that guide individual participation in online communities including visiting the website, posting stories, and voting for stories. With these findings they built an agent based model.

In 2016 another work is done by Abir De et al. [3]. Their aim was to find data driven model of opinion dynamics which should accurately forecast user's opinion. The author proposed SLANT, a probabilistic modeling framework of opinion dynamics. This model represents user's opinions over time by means of marked jump diffusion stochastic differential equation, and allows for efficient model simulation and parameter estimation from historical fine grained event data. Later the framework is used to derive a set of efficient predictive formulas for opinion forecasting and identify conditions under which opinions converge to a steady state. For this work the data is gathered from Twitter.

With increase in interest in understanding how individuals form their opinion another work is done in 2017 by Susana Iglesias Rey et al. [4]. The study proposes a general op n on dynamics model and an evolution of interpersonal influence structures based on the model of reflected appraisals proposed by Freiedkin. The study shows that DeGroot's and Friedkin Johnsen's models of opinion dynamics and their evolution of interpersonal influence structures are particular cases of our proposed model. Further they proved the existence of equilibrium.

In 2018 Chiara Ravazzi et al. [5] propose a technique for the estimation of the influence matrix in a sparse social network, in which n individual communicate in a gossip way. The opinions evolve according to a Friedkin and Johnsen mechanism. They provide two method namely dense method and sparse method. In dense method the estimated influence matrix is directly computed from the estimated state covariance matrices and in sparse method common relaxations of sparsity are used to estimate the influence matrix that has the smallest number of connections.

Later in 2018 Sissi Xiaoxiao Wu et al. [6] proposed a new strategy to extract the opinion dynamics model through collecting votes from people. The aim was to develop a "*discuss then vote*" model as a generative model for the observed votes. In this the votes are casted after a discussion period of opinion exchanges. The Bayesian framework is used to formulate the inference problem for utilization of an opinion dynamics model with the existence of stubborn agents. Based on the inferred model, they derived a vote prediction procedure to predict on the vote outcomes by evaluating upper and lower bounds on the likelihoods. Inclusion of stubborn agents is used to identify the influence matrix and the network's topology. The success of this study depends on the number of stubborn agent's relative to the sparsity of the network and the amount of voting data available. In this paper author also analyzed this method on [7] United States (US) Senate's voting data, which is available in the US congress dataset.

III. COMPARIVTIVE STUDY ON DIFFERENT PAPERS :

The Table 1 summarizes the opinion dynamics models for different networks.

Table 1: Opinion dynamics models at different networks.

Author	Topic	Ind:	Opinion expression	Model	Network
V. Sood, S. Redner	Voter model on heterogeneous graphs	[8]	Discrete opinions	Voter model	SF network and ER network
F.A. Rodrigues, DAF. Costal	Surviving opinions in Sznajd models on complex networks	[9]	Discrete opinions	Sznajd model	Regular lattice, ER network, SW network and SF network
V. Kandiah, D.L. Shepelyansky	Pagerank model of opinion formation on social networks	[10]	Discrete opinions	The Page Rank opinion formation (PROF)model	Real directed networks
H. Han, C. Qiang, C. Wang, H. Jing	Soft control for collective opinion of weighted DeGroot model	[11]	Continuous opinions	DeGroot model	SF network
J. Peng, A Mirtabatabaei, N.E. Friedkin, F. Bullo	Opinion dynamics and the evolution of social power in influence networks	[12]	Continuous opinions	DeGroot–Friedkin model	Influence networks
L.X. Wang, J. Mendel	Fuzzy opinion networks: a mathematical framework for the evolution of opinions and their uncertainties across social networks	[13]	Continuous opinions	Fuzzy opinion model	Fuzzy opinion network

IV. BASIC MODELS USED IN OPINION DYNAMICS

A. DeGroot model :

The DeGroot model is considered as classical model. When W does not change over time or with opinions, Eq. (1) is called the DeGroot model. In this model, the agents' opinions are continuous, and it is generally assumed that xi(t)∈R.

$$X(t+1) = W \times X(t),\ t = 0, 1, 2, \ldots \quad \ldots\ldots\ldots \text{Eq. (1)}$$

Where w = $(wij)n*n$ and $X(t) = (x(t), x(t), \ldots, xn(t))^{\wedge}T \in R\ n$

It is proved that the consensus opinion is a linear combination of the initial opinions of all agents, and the combinational coefficients are related to the eigenvector associated with the Eigen value 1 of the matrix W. The result presented in DeGroot have been used as a basis for determining whether and how consensus can be reached in the social network DeGroot model.

B. Voter model :

The voter model was introduced in Clifford and Sudbury and Holley and Liggett. The vector model describes the social dynamics of public choices on social issues. In this model, all agents are placed in regular lattices, each agent's opinion is denoted as a binary variable, and an agent updates user opinion based on that of a randomly selected neighbor. The vector model is as follows.

Let $A = \{A1, A2, \ldots, An\}$ be the set of agents and t be a discrete time. Let x (t) be the binary opinion of agent A , where $x(t) = 0$ or $x(t) = 1$. All of the agents are placed into a lattice B with $\lceil n \rceil \times \lceil n \rceil$. Let assume that agent A is placed in the k column and L row of B (i.e., bkl); then agent A has four neighbors. Clearly, four neighbors are the agents placed in the positions $bk\ 1,l$, $+\ bk\ 1,l$, $+\ bk,l\ 1$, and $-\ bk,l\ 1$ and $bk,l\ 1$. Agent A randomly selects one of the four neighbors. Without loss of generality, assume that agent Ai selects neighbor Aj, placed n $bk\ 1,l$. Let $xi(t+1)$ be the op n on of agent A at t me $t+1$. Then, $xi(t+1) = xj(t)$.

V. THE APPLICATIONS OF OPINION DYNAMICS

The applications of opinion dynamics in different fields like markets, political elections, public opinion management and transportations are given.

- Political elections:
  - To predict the election results.
  - Influence estimation.

- Market:
  - For advertising in market.
  - To plan strategy of competition between groups.

- To describe stock and option price formation
- To help users in selection of right products.

- Public opinion management:
- In mass media communication.
- To detect opinion propagation patterns on social media.

- Transportation:
- Transport planning.
- To enhance the reliability of vehicle velocity estimators.

VI. CONCLUSION

In this paper author have reviewed the basic models in opinion dynamics [DeGroot model and vector model]. It is learn that, in this era of social-networking opinion dynamics plays an important role for opinion estimation. Several opinion dynamic models are used in different network. There are the applications of opinion dynamics in different fields like markets, political elections, public opinion management and transportation.

REFERENCES

[1] Yucheng Donga, Min Zhana, Gang Koub, Zhaogang Dingc, Haiming Liang, "A survey on the fusion process in opinion dynamics", Information Fusion 43 (2018) 57–65.
[2] Armin Ashoui Rad, Hazhir Rahmandad and Mehdi Yahyanejad, "Estimating the Dynamics of Individual Opinions in Online Communities", Conference Paper, ReserchGate (2014).
[3] Abir De, Isabel Valera, Niloy Ganguly, "Learning and Forecasting Opinion Dynamics in Social Networks", 30th Conference on Neural Information Processing Systems, Barcelona, Spain, (NIPS 2016).
[4] Susana Iglesias Rey, Patricio Reyes, Alonso Silva, "Evolution of Social Power for Opinion Dynamics Networks", 55th Annual Allerton Conference on Communication, Control, and Computing, Oct 2017, Monticello, Illinois, United States, (2017).
[5] Chiara Ravazzi, Sarah Hojjatinia, Constantino M. Lagoa, Fabrizio Dabbene, "Randomized opinion dynamics over networks: influence estimation from partial observations", IEEE Conference on Decision and Control (CDC),(2018).
[6] Sissi Xiaoxiao Wu, Hoi-To Wai and Anna Scaglione, "Estimating Social Opinion Dynamics Models from Voting Records", IEEE, (2018) 4193 - 4206.
[7] US congress roll call data collected from the 114th Congress during the period of January 1, 2015 to September 28, 2016, https://www.govtrack.us
[8] V. Sood, S. Redner, "Voter model on heterogeneous graphs", Phys. Rev. Lett. 94 (17) (2005) 178701.
[9] F.A. Rodrigues, DAF. Costal, "Surviving opinions in Sznajd models on complex networks", International Journal of Modern Physics (2005) 1785–1792.
[10] V. Kandiah, D.L. Shepelyansky, " Pagerank model of opinion formation on social networks", Phys. A Stat. Mech. Appl. (2012) 5779–5793.
[11] H. Han, C. Qiang, C. Wang, H. Jing, " Soft-control for collective opinion of weighted DeGroot model ", Journal of Systems Science and Complexity (2017) 550–567.
[12] J. Peng, A Mirtabatabaei, N.E. Friedkin, F. Bullo, " Opinion dynamics and the evolution of social power in influence networks ", Society for Industrial and Applied Mathematics, (2015) 367–397.
[13] L.X. Wang, J.M. Mendel, " Fuzzy opinion networks: a mathematical framework for the evolution of opinions and their uncertainties across social networks ", IEEE Transactions on Fuzzy System , (2016) 880–905.
[14] J.R.P. French, " A formal theory of social power " , American Psychological Association, Psychological Review, (1956) 181–194.