

Global Stability Analysis of Rumor Propagation in Social Networks

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ABSTRACT

Rumor propagation is a typical form of social interaction that has a negative effect on society and human life. The study of rumor dissemination and regulation on social networks is significant and vital. The propagation of rumors is caused by a variety of circumstances. In this study, we take into account how people react to rumors differently depending on their personalities and levels of comprehension. In order to categorize the entire human population, we use the terms susceptible (S), exposed (E), infected (I), and recovered (R).

The dynamics of rumor transmission in social networks are represented by differential equations. The spreading threshold of the SEIR model in social networks is then obtained using the Jacobian matrix and the Next Generation matrix. Then the equilibrium's existence and stability are analyzed. It is established that rumor-free equilibrium E_0 is locally asymptotically stable if the basic reproduction number is low, which means rumor has stopped spreading in a population, and unstable if the basic reproduction number is high, which means new rumor is spreading in the population. Finally, in order to validate the analytic findings, numerical simulations of the dynamic model are run on the system using MATLAB.

Keywords: epidemic model, equilibrium point, reproduction number, stability

1. INTRODUCTION

News manipulation has been a significant endeavor for nearly everyone since ancient times. In the olden days, it was used to be done orally, but nowadays, the use of social networks, both online and offline, is common. Manipulated news or information, or rather, rumor, has discovered a strong medium called the Internet for its rapid and simple transmission. Because of their validity, confirmed or unconfirmed information is difficult to accept, but it has a significant influence on social networks and daily life [1–2].

In recent years, the popularity of online social media has increased dramatically. People can communicate more easily through social media. Meanwhile, the strategy allows untrustworthy sources to disseminate enormous volumes of unconfirmed material to individuals [3–7]. Rumours can thus spread more swiftly and broadly via online social media than through conventional offline social networks. The widespread transmission of disinformation may cause chaos in people's lives, especially when they are dealing with religious or political issues. This suggests that it is critical for social media to recognize disinformation in real time in order to restrict the spread of rumors [8]. Social communication has become incredibly quick and simple due to the development of social networking applications like blogs, instant messengers, social networking websites (like Facebook, Renren, and Wechat in China, and Vkontakte in Russia), professional networking websites (like LinkedIn), microblogging platforms (like Twitter and Weibo in China), and virtual worlds (like Second Life) [9].

Generally speaking, rumors are described as unsubstantiated elaborations or annotations of public items, events, or concerns that are created and spread through a variety of media, which can lead to unwarranted public worry and economic loss for the affected nations. What's worse is that rumors have spread more swiftly and extensively as a result of the advent of network connections [10]. As a result, understanding the theory behind rumor spreading is crucial since it may help manage and restrain the spread of rumor.

Researchers' interest in the transmission of rumor in intricate social networks has lately increased [11]. They establish the features and examine the crucial threshold of rumor propagation in the complex networks by describing the dynamics of the models using matching mean-field equations.

They establish the features and examine the crucial threshold of rumor propagation in the complex networks by describing the dynamics of the models using matching mean-field equations. The first conventional DK rumor propagation model was introduced in 1965 by Daley and Kendall [12]. Researchers studied the rumor using a mathematical model and created another formal model. Early classical models of rumor dynamics made the assumption that everyone had a uniform chance of connection [13–16]. These straightforward models obviously fall short of