

**MODELING THE DIFFUSION OF INFORMATION IN
DYNAMIC SOCIAL AND COMMUNICATION
NETWORKS**

By

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ABSTRACT

Social and communication networks play a fundamental role in the spread of information, ideas, and innovations. We present a general model of diffusion in dynamic large-scale social and communication networks, where the flow of actionable information requires the node to make a decision or take an action. The network structure may change over time as the result of the information flow. The diffusion model consists of parameterized axioms and incorporates trust between individuals and information sources. Trust is used as a measure of the likelihood that individuals will believe the message being conveyed to them. The general framework is configurable and can be extended to fit various diffusive processes as well as used to study algorithms and strategies for promoting and/or inhibiting diffusive processes.

Empirical experiments were performed to observe the effect of network structure, seeding strategy, and trust distribution on the spread of actionable information. The simulation results show that the effectiveness of the diffusion is dependent on the network structure and seeding strategy used in delivering the initial broadcast. We find that social groups as modeled using trust has an important impact on the diffusion process and that in certain scenarios, inhomogeneity in trust can have a positive effect on the diffusion.

We calibrated the diffusion framework using actual data sources to simulate the spread of evacuation warnings in the scale of one million nodes. The constructed models were then used to explore the role of strong and weak ties and distribution of trust in a large-scale wildfire evacuation scenario. In the context of emergency warnings, strong ties within social groups are important for providing trust in the information that is passed, but weak ties between social groups are also important for information to effectively reach more individuals across the social network. Assuming that an individual has a fixed number of contacts, there exists an optimal configuration of strong and weak ties that results in the most efficient spread.

We extend the model to incorporate the concept of an abort process, whose purpose is to inhibit an ongoing diffusive process. The idea is to introduce diffusive

counter messages into a network to interfere with an ongoing diffusion and stop the action that was prescribed by the previous messages. Strategies for broadcasting the abort message are studied under various experimental configurations. For each strategy, we identify scenarios where the strategy is useful and scenarios where they are ineffective. We identify that there is a trade off between a fast effective spread of actionable information and the ability to retract the information or effectively utilize an abort. Findings also suggest that alternate strategies will have to be explored to incorporate group structures and the distribution of trust in designing a useful abort mechanism.