# Position Paper: Responsive social networks

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## Introduction

The research idea presented here contributes to the effort to make social and other kinds of networks more responsive to events happening in geographic space. Consider the scenario of a wild-fire developing in a populated region, where neighbors begin to communicate with each other using cell phones and social networking software such as Facebook. As the fire develops and moves, traditional central and hierarchical means of communication and control break down, but others need to be alerted. The network of communications between neighbors needs to develop in parallel with the development of the fire, so that information is shared and appropriate actions are taken. There may also be the need for some time-critical, collaborative activities, such as the creation of a dynamic map, so that the entire group can see the boundaries and properties of the fire as it develops. All these activities will be facilitated by the development of a network of communications that is responsive to changing needs. The development of such a model is the focus of this research.

## Outline of the model

Figure 1 shows the basic idea. A spatially embedded network evolves to meet changing needs. The figure shows the state of the network at two moments in time, as it responds to the movement of a front of some event of interest. The dark filled nodes represent active nodes, and the unfilled nodes are quiescent. As the front moves, the network needs to track the movement, and so the pattern of active-quiescent nodes changes, as does the edge configuration. We say that the dynamic network is responsive to the movement of the front. In this case the nodes are stationary.

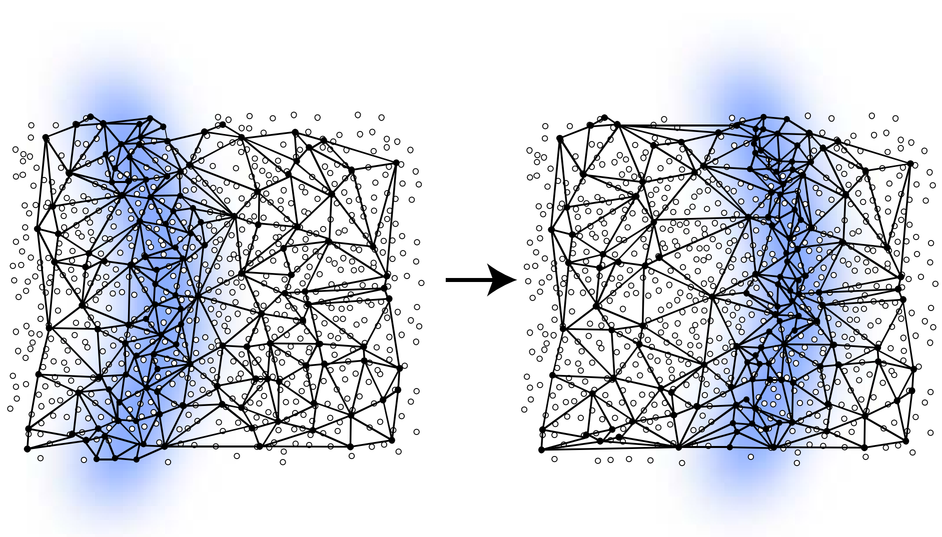

Figure 1: Network responding to movement of a front

Formally, we assume a directed graph embedded in space-time. Because of temporal auto-correlation, we model this as a temporal sequence of spatially embedded graphs. We also note that because of spatial auto-correlation, two spatially close nodes are more likely to be connected than two distant nodes.

There are several forms that responsiveness can take.

- Nodes are created and deleted
- Nodes transpose awake-asleep
- Nodes move
- Edges are created and deleted
- Edge weights change
- Nodes' spatial embeddings change
- Edges' spatial embeddings change

There is also the issue of to what the network is aimed to be responsive. We assume for this work that the network is responding to a dynamic field - a pattern of variation of a scalar or vector quantity over a surface (assumed to be part of the surface of the Earth). Another possibility might be responsiveness to the changes to a collection of spatial objects (e.g., points, regions).

## Approach

We have already done extensive work on sensor networks responding to dynamic fields. We have constructed a model of spatial change [2,5,9] and constructed algorithms for detecting basic changes, particularly qualitative and topological changes, in a decentralized manner [1,3,4,6,7,8]. That is, the determination of change is computed entirely within the network, with no external controller. We aim to extend this approach to the problems described above. Our focus is on models and algorithms, and our principal domains of interest are in volunteered geographic information in time-critical and emergency situations.

## References


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